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A Record of the Progress of Pharmacy and the Allied Sciences

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THE AMERICAN
JOURNAL OF PHARMACY

VOL. 103 DECEMBER, 1931 NO. 12

EDITORIAL

THEN AND NOW

AND A MERRY CHRISTMAS ANYWAY!

"Santa Claus is dead"!

"The Spirit of Christmas has vaporized"!

"The Old Yule Log is water-soaked and there is no warmth in it"!

"The Christmas Stocking is only an empty sleeve and Christmas mirth a myth"!

SO runs the anvil chorus of a mighty host of pesky pessimists, in whose lexicon, right now, there are no such words as hope and happiness. Only hate is in their heart, and on their lips a loveless litany.

Their tomorrows are mortgaged with gloom and evil-filled are all their prophecies. Peace and good will are not of their earth, and the birthday of the baby of Bethlehem not of their celebration.

By the way these are the same people, who, when their goose hung high, prostituted the holy season with a queer sense of commerce and converted the creed of Christmas into the crassest coin.

But now that prosperity's tide is at the ebb they are only harbingers of horrors, with hardly a word of hope for better times.

Dull days have always hatched such dunces—markers of depression and in part, makers of it, too.

It was always thus!

Read this abstract of an essay written just a hundred years ago and note its pertness.

Macaulay—Lord Macaulay—the English historian wrote it for the *Edinburgh Review*. Note the strange parallel between 1831 and

1931. Note too, that the writer turns historic but not hysteric—and that even better than his history is his truly remarkable gift of prophecy and prognosis.

Gather from its reading a bit of optimism—and added confidence for the coming days. Santa Claus is NOT dead—and the little baby for whose birth "there was no room at the inn"—still stands a signal symbol of peace on earth and good will towards men.

"History is full of the signs of this natural progress of society. We see in almost every part of the annals of mankind how the industry of individuals, struggling up against wars, taxes, famines, conflagration, mischievous prohibitions and more mischievous prohibitions, creates faster than Government can squander and repairs whatever invaders can destroy. We see the capital of nations increasing and all the arts of life approaching nearer and nearer to perfection in spite of the grossest corruption and the wildest profusion on the part of rulers.

"The present moment is one of great distress. But how small will that distress appear when we think over the history of the last forty years—a war, compared with which all other wars sink into insignificance; taxation, such as the most heavily taxed people of former times could not have conceived; a debt larger than all the public debts that ever existed in the world added together; the food of the people studiously rendered dear; the currency imprudently debased and improvidently restored. Yet is the country poorer than in 1790? We fully believe that, in spite of all the misgovernment of her rulers, she has been almost constantly becoming richer and richer. Now and then there has been a stoppage, now and then a short retrogression; but as to the general contingency there can be no doubt. A single breaker may recede, but the tide is evidently coming in.

"If we were to prophesy that in the year 1930 a population of 50,000,000, better fed, clad and lodged than the English of our time, will cover these islands—that Sussex or Huntingdonshire will be wealthier than the wealthiest parts of the West Riding of Yorkshire now are; that cultivation, rich as that of a flower garden, will be carried up to the very tops of Ben Nevis and Helvellyn; that machines, constructed on principles yet undiscovered, will be in every house; that there will be no highways but railroads, no travelling but by steam; that our debt, vast as it seems to us, will appear to our great-grandchildren a trifling encumbrance, which might easily be paid off in a year or two—many people would think us insane. We prophesy

nothing; but this we say: if any person had told the Parliament which met in perplexity and terror after the crash of 1720 that in 1830 the wealth of England would surpass all their wildest dreams, that the annual revenue would equal the principal of that debt which they considered an intolerable burden—that for one man of £10,000 then living there would be five men of £50,000; that London would be twice as large and twice as populous, and that, nevertheless, the mortality would have been diminished to one-half what it was then; that the post-office would bring more into the exchequer than the excise and customs had brought in together under Charles II; that stage coaches would run from London to York in twenty-four hours; that men would sail without wind, and would be beginning to ride without horses—our ancestors would have given as much credit to the prediction as they gave to Gulliver's Travels. Yet the prediction was then true; and they would have perceived that it was not altogether absurd if they had considered that the country was then raising every year a sum which would have purchased the fee-simple of the revenue of the Plantagenets—ten times what supported the Government of Elizabeth—three times that, in the time of Oliver Cromwell, what had been thought intolerably oppressive. To almost all men the state of things in which they have been used to live seems to be the necessary state of things. We have heard it said that 5 per cent. is the natural interest of money, that twelve is the natural number of a jury, that forty shillings is the natural qualification of a county voter. Hence this, that though in every age everybody knows that up to his own time progressive improvement has been taking place, nobody seems to reckon on any improvement during the next generation. We cannot absolutely prove that those are in error who tell us that society has reached the turning point—that we have seen our best days. But so said all who came before us—with just as much apparent reason.

"'A million a year will beggar us,' said the patriots of 1640.

"'Two millions a year will grind the country to powder,' was the cry in 1660.

"'Six millions a year and a debt of fifty millions!' exclaimed Swift, 'the high allies have been the ruin of us.'

"'A hundred and forty millions of debt!' said Junius. 'Well may we say that we owe Lord Chatham more than we shall ever pay, if we owe him such a load as this.'

" 'Two hundred and forty millions of debt!' cried all the statesmen of 1783 in chorus. 'What economy on the part of a Minister can save a country so burdened?' We know that if, since 1783, no debt has been incurred, the increased resources of the country would have enabled us to defray that burden, at which Pitt, Fox and Burke stood aghast—to defray it over and over again, and with that much lighter taxation than we have actually borne. On what principle is it, that if we see nothing but improvement behind us, we are to expect nothing but deterioration before us?

"It is not by the intermeddling of Mr. Southey's—the omniscient and omnipotent state—but by the prudence and energy of the people, that England has hitherto been carried forward in civilization; and it is to the same prudence and the same energy that we now look with comfort and good hope. Our rulers will best promote the improvement of the people by strictly confining conditions to their own legitimate duties, by leaving capital to find its most lucrative course, commodities their fair price, industry and intelligence their natural reward, idleness and folly their natural punishment; by maintaining peace, by defending property, by diminishing the price of law, and by observing strict economy in every department of the State. Let the Government do this—the people will assuredly do the rest."

—And Macaulay's contribution to the *Edinburgh Review* in 1830—might just as well have been written, with slight changes, for the *New York Times* in 1930.

Ivor Griffith.

THE VALE OF THE NIGHTSHADES

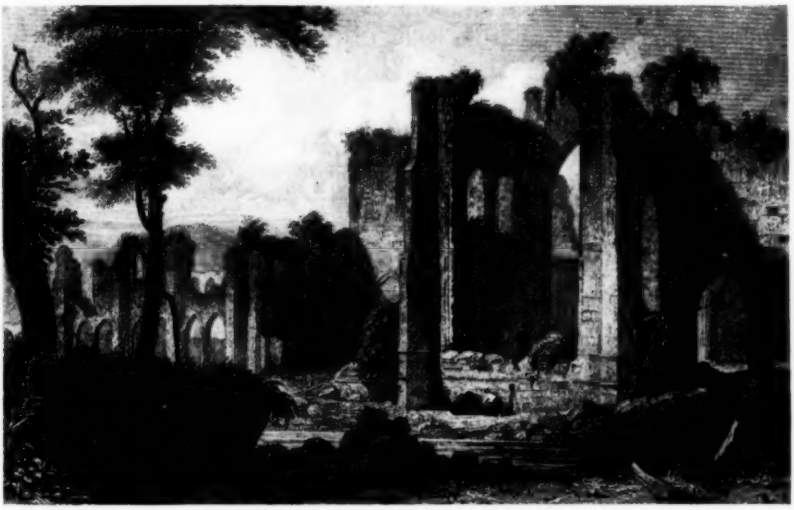
By Fred B. Kilmer

In many lands, but especially in England, drug plants seem to thrive in the most sacred and historic spots.

In the remains of Roman and other ancient fortresses covered with the decay of many centuries, among the weeds rooted in ivy-covered walls, drug plants are seen to appear. Around the castle grounds of King Cynewolf, the gathering of henbanes and hellebore is quite an industry. Over the remains of Richard Baxter there is a patch of elaterium. Tom Fiddler's ground is a field of lavender.

The narcotic nightshades have long been associated with romantic and picturesque spots. The hyoscyamus grew on the tombs of the Greeks and Romans. The famous mandragora, or mandrake, was called the "little gallows' man" by reason of its reputed propensity to grow at the crossroads under the gibbet, nourished by the bloody sweat of the malefactor. The daturas festoon the temples of the American Indians.

Spectres, witches and bogies float in the mists that hover over the plains, hills and glens of "Lakeland by the Silver Sea" on the west coast of England. Here a secluded, picturesque glen carries



Furness Abbey, in the Vale of the Nightshade, Lancashire.

a name that will not perish as long as the story of the English people survives. The magic name is "The Vale of the Nightshades." In the midst of the vale lie the mouldering ruins of Furness Abbey, the mediaeval home of the Benedictine Monks. In the grounds of the abbey the shadows of an herb garden cultivated in the middle ages remain. A square enclosure surrounded by a wall and hedge. Turfed paths can be plotted out, running with picturesque irregularity. Piles of stones reveal the crumbling remains of a pergola, an archway, a sundial and a shrine. In this garden the monks labored diligently and the earth brought forth. Herbs grew in this garden. Herbs for the healing of the ills of mankind. Savory herbs for the refreshment of body and soul. Flowers with which to strew the floor and deck the altar of the sanctuary. In the tangled mass of stones, bush and weeds there still remain many herbs which have carried on from seeds sown by the hooded Benedictines.

The nightshades, including henbane, belladonna and bittersweet, fill the now weed-grown garden of the monks. Their roots penetrate the crumbling walls of the cloister. From thence the nightshades have spread through the vale on to the fields as a bane to the tillers of the soil.

During the stirring times of the Reformation, the abbey was despoiled, and the monks were driven away. Through the centuries run tales of the spectres of the monks and the hosts of Satan contending for mastery amid the fields of the "deadly nightshades."

When the nightshades flourish, it was the devil who scattered the seed and watered the soil. The heavy, malodorous air arising from the plants is the "witches' perfume." At night the leaves and flowers glow with the light of the "devil's candle." As the purple berries become plentiful and more deadly, they are truly the "devil's berries."

Inside the jagged abbey walls the nightshades have covered the most hallowed spots, and thus we see the "witches' altar" and the "devil's pulpit."

As the tales run, the pulses of the past vibrate again. In the roofless aisles ghostly figures of cowled monks glide to and fro, kneeling and crying to the Lord to uproot the evil nightshades, drive out the works of Satan and avenge the desecration of high places. As the centuries rolled on through the valley, did madness appear among the people, the victim must have partaken of the "insane

root." Sudden illness or death meant that the witches and sorcerers had instilled venom into the nightshades. A heavy hand fell upon anyone accused of witchcraft if seen hovering in the vale.

As from the monks' gardens the solanums have spread through glen and field, so have rolled on from generation to generation the legends of "the Vale of the Nightshades."

FRED B. KILMER.

ORIGINAL ARTICLES

HOW DO WE SEE?*

By Horatio C. Wood, Jr., M. D.

WERE I to ask you "How do we see?" I presume the most of you would reply without hesitation, "With our eyes, of course." But at that you would be wrong. I have an acquaintance whose eyes are as perfect as mine and yet he is stone blind. It would be nearer the truth—yet not all of it—to say that we see with our brain. But although, properly speaking, we do not see with our eyes, we cannot see without them.

Horatio C. Wood, Jr., M. D.

SEEING "THINGS"

Most persons think they see things, but really they only see ideas. The man who has been over-indulgent in spirituous beverages may believe he sees pink elephants and horrid crocodiles within the limits of his bedroom, but you and I know that there are no elephants or crocodiles there. There is not one of us, even the total abstainers among us, who has not some time seen a ghost or a robber or a wild animal which subsequent investigation showed to be non-existent. Even when we look at a real object we do not see it; all that we perceive are the rays of light which are reflected from that object. A dead black surface is one which reflects no light and we do not see it at all. If the surroundings are such as to encourage the thought that we see nothing, we conclude there is nothing there and call it a hole, but if the blackness occurs in a position where we should not expect a hole, we think that we see a black surface.

We may liken the process of seeing to that of taking a photograph. Three things are necessary for a photograph; a camera, a sensitive film and a developer. All these have their analogues in our visual apparatus.

*One of a Series of Popular Science Talks given at the Philadelphia College of Pharmacy and Science, 1931 Season.

A camera consists essentially of (1) a light-proof box, (2) a diaphragm (or stop) to regulate the amount of light entering the camera (3) a lens to focus the rays of light, and (4) a shutter. The human camera is the eyeball.

THE CAMERA The eyeball is an irregular spheroid about 1¼ inches in diameter. If we cut this globe in half we will see that it consists really of two somewhat flattened, hollow globes. The larger one, behind, makes up some three-quarters of the total bulk. This larger proportion, called the posterior chamber, is a sort of sac made of a leather-like material called the *sclera* and

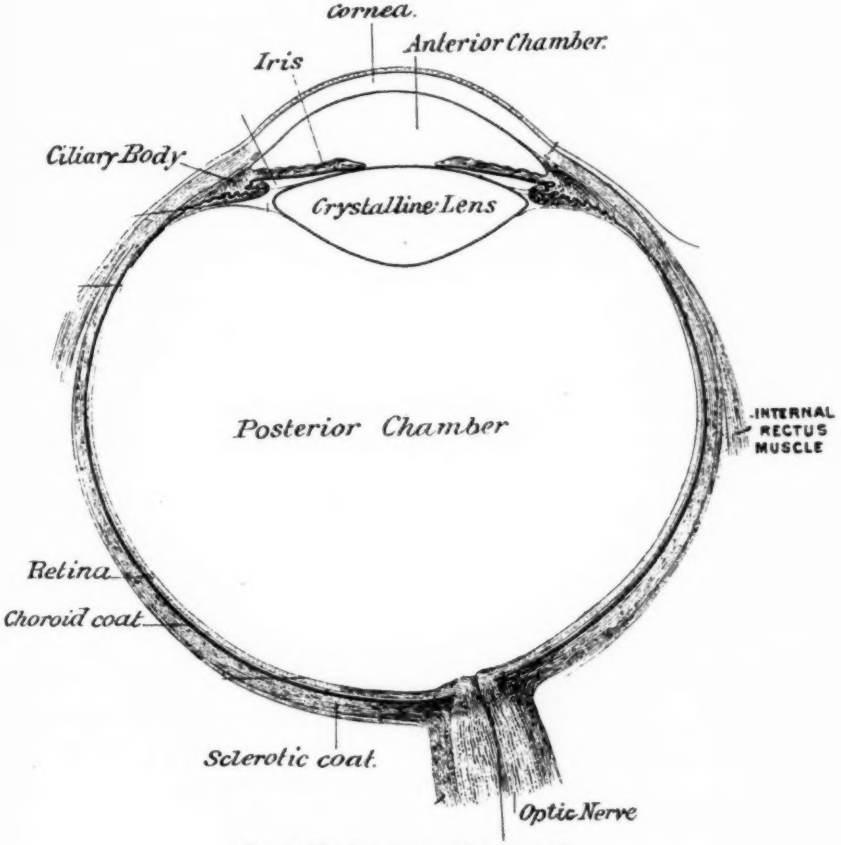


Fig. 1—The Structure of the Eye-ball.

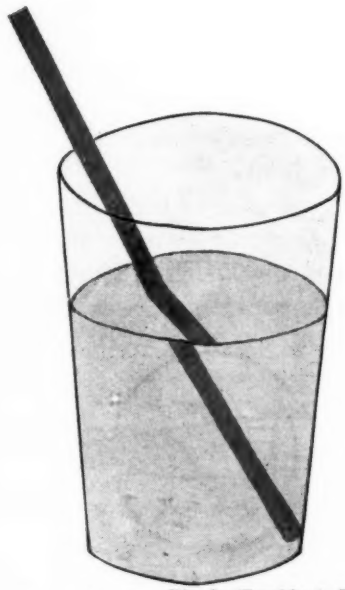
containing a transparent jelly-like mass called the vitreous. A portion of the sclera can be seen ordinarily as the white of the eye. The anterior chamber is filled with a liquid which is almost pure water containing a trace of salt. It is separated from the posterior chamber by an ovoid body, of a relatively firm consistency, known as the crystalline lens. The front wall of the anterior chamber is made up of a transparent, rather tough material called the cornea. Over the whole of the visible portion of the eyeball there is spread a delicate mucous membrane, continuous with that lining the eyelids, and known as the conjunctiva.

THE DIAPHRAGM Immediately in front of the crystalline lens hangs an opaque curtain, made up largely of muscle tissue. It is the *iris,* which forms the colored part of the eye. In the middle of the iris is a hole—the *pupil,* through which the rays of light pass into the eyeball. There are two sets of muscle fibers in the iris, one set being arranged in a circular direction, the other radiating like the spokes of a wheel. When we face a bright light the circular fibers contract and make the pupil smaller so as to shut out some of the excess light. The pull of the radiating fibers makes the pupil larger so as to permit as much light as possible to enter. The arrangement is for the same purpose as the diaphragms—or "stops"—which are used in the camera. Indeed the modern cameras have attempted to copy the action of the pupil, and use what is known commercially as an "iris diaphragm"; and yet when we compare it with the real eye, we see how clumsy are man's efforts at imitating nature. The human pupil whether contracted or dilated is as near a perfect circle as one can well imagine, but the iris diaphragm is not a circle at all but contains a number of corners which become especially obvious if the opening is diminished.

THE LENS The third part of the camera is the lens. This is very obviously duplicated in the eye.

To understand the purpose and mechanism of the lens we must have some knowledge of the laws governing the passage of light. I, therefore, shall digress for a short space from physiology to explain certain optical principles involved in vision.

Suppose we imagine a point of light so small that it has neither length nor breadth, but only brightness. From this point the rays of



light proceed in all directions, travelling always in a straight line unless they meet something which deflects them. If we interpose in their pathway a transparent medium, differing from that in which they are travelling, some of them will be bent more or less. We call this bending of the rays of light, refraction. You have all noticed that if you put a stick into a glass of water and look at it through the walls of the tumbler, it seems to be broken at the place where it enters the water. If the surface of this interposed

Fig. 2—(Tumbler.) To Show Refraction by Water.

The rays of light coming from the stick are bent in passing from the water to the air, which gives the appearance that stick is not straight.

body be curved outwards, that is convexly, then the rays of light will all be bent inwards towards the middle. For instance, in Fig. 3 the

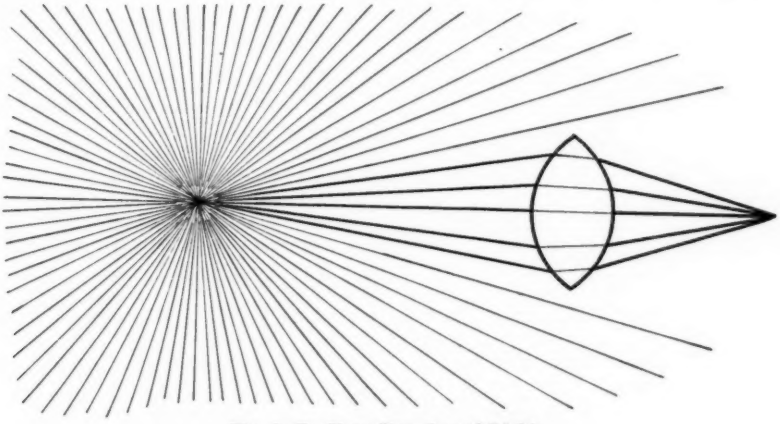


Fig. 3—To Show Focusing of Light.

The rays of light come from the point, in all directions, in straight lines. Those rays which strike the convex lens are bent inwards so that they come to a point behind the lens.

straight lines represent rays of light issuing in all directions from a point. Some of these rays impinge against the doubly convex lens and are so bent that they come to a point back of the lens. The distance behind the lens at which parallel rays of light are converged is called the focal length and depends on the degree of curvature and the character of the material of which the lens is made.

The angle of refraction, that is the degree to which the rays are bent is always the same for any given lens. If we move the point of light nearer to the lens some of the rays will strike the lens at a wider angle and, always being bent to the same degree, will come to

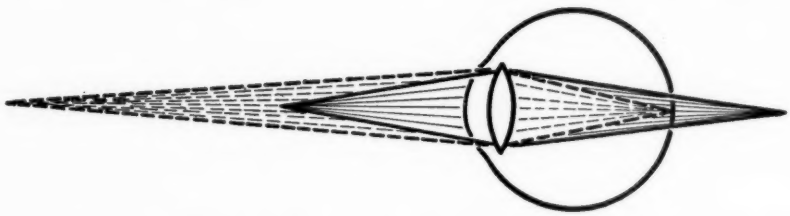


Fig. 4—To Show Why Near Objects Are Focused Further From the Lens.
The angle of refraction by the lens is always the same. The solid line, representing the light-rays from a distant object, which come to a focal point on the retina. The rays from a near object, represented by the dotted lines, being bent to the same degree, focus further back.

a focus further back of the lens. In photography we compensate for the increased focal distance of near objects by lengthening the distance from the lens to the sensitive film but the eyeball cannot be lengthened to accommodate itself for near objects. Nature therefore has arranged another mechanism by which the same result is achieved; that is, by changing the curvature of the lens. The more sharply curved a lens is the greater is the angle of refraction; by using a more nearly globular lens we get a shorter focal distance. When we want to see things close at hand, by the pull of certain muscles, called the ciliary bodies, the curvature of the lens is increased, and the object is brought to a sharp focus at the proper distance back of the lens.

VERY ACCOMMODATING

It should be noted in this connection that this focusing, or as it is technically called "accommodation" of the eye, is brought about by muscular effort and if continued too long produces a sense of fatigue as will any other

continued muscle tension. Try to hold your arm out straight for a few minutes and it will become quite painful. The same principle applies to the ciliary muscle. A steady continuous pull becomes quite distressing. When we look at a distance the muscle relaxes and allows the lens to go back to its normal curvature. That is the reason why it is always good practice when reading or doing any other close work to look across the room every few minutes to allow the muscle to relax.

Sometimes persons have eyeballs too short, or lenses too flat so that it is necessary for them to be constantly pulling with their ciliary muscles to see clearly at a distance of even five or ten feet

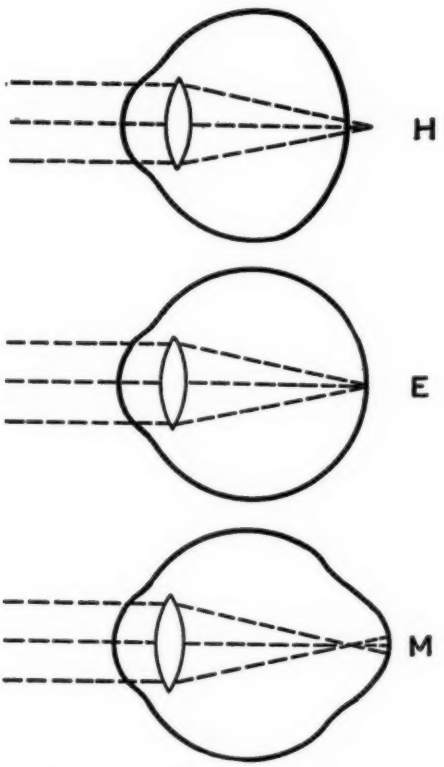


Fig. 5—To Illustrate Common Refractive Errors of the Eye.
M is a myopic (near-sighted) eye; E is an immetropic (normal) eye; H is a hyperopic (far-sighted) eye.

away. This is commonly called "far-sightedness," which is a rather unfortunate term because these persons do not see any better at a distance than the rest of us, they only have more difficulty in seeing near objects. The doctor calls it *hyperopia*. These persons must exert their eye muscles more continuously than those with normal sight and therefore are likely to suffer from headache and other symptoms of eye strain.

THE LONG AND SHORT OF SIGHT

Most babies are far-sighted. The reason for this is that the lens of a new-born baby has practically the same curvature as that of the adult's, but its eyes are considerably smaller. Consequently, the diameter of the eyeball being shorter than the focal length of the lens, the picture would fall too far back. But the power of accommodation in the young is very high and the baby is able to focus enough to see clearly. However, the constant strain on the eye often leads to abnormalities, such as "cross-eye" or astigmatism, which may be permanent. Young children should use their eyes for close work only for very limited periods.

On the other hand if the eyeball be too long then the rays of light are focused in front of it and have crossed again before they touch the sensitive film and again we get a blurred image. This constitutes what is known as near-sightedness, or *myopia*. Nature has provided us with no mechanism for flattening out the lens to lengthen the focal distance. Far-sighted persons can overcome their ocular deficiency and see near objects sharply by muscular effort, but near-sighted persons are helpless to do anything to see the distant objects sharply. On the other hand, they have this compensation that they do not have to strain their eyes so much to see near at hand and rarely do they suffer from headaches or other effects of eye strain.

Another common defect of the lens is irregularity of curvature as the result of which the rays in the perpendicular plane do not focus at the same point as those in the horizontal plane. This constitutes what is known as astigmatism.

All of these errors of refraction can be corrected by the aid of a secondary lens. For example, if our focal distance is too long, we put in front of our eye a convex lens which begins to bend the rays before they reach the eye and thus makes the focal distance shorter.

For near-sighted person we use a concave lens which spreads the rays of light outwards to compensate for the too great curvature of the lens of the eye.

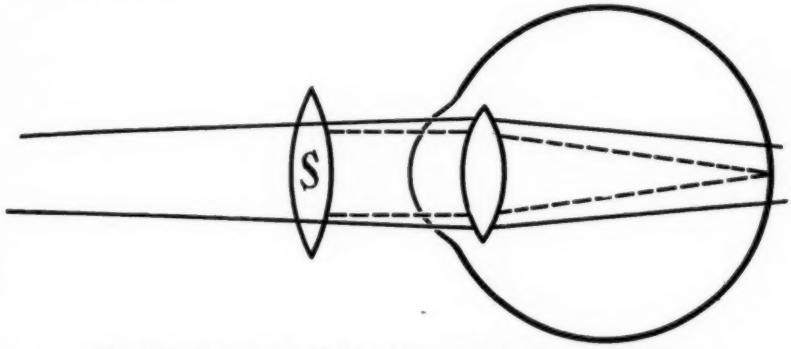


Fig. 6—To Show the Correction of Hyperopia by Means of Glasses.

The natural lens does not refract the rays of light to bring them to a focus on the retina. An extra convex lens put before the eye brings the divergent rays more nearly parallel so that the refraction of the natural lens focuses them exactly on the retina.

OLD EYES The far-sightedness of old age is a very different thing from the far-sightedness of the baby. The loss of focusing power, which comes to all of us as we grow older, is not due to a change in the shape of the lens or the length of our eyeball, but is the result of increasing stiffness or hardness which affects all our body and makes the lens stiffer so that our muscles are unable to pull it into a curved position. We have therefore to assist our waning physical powers by means of an extra pair of glasses.

When the doctor is testing eyes what he wants to find out is the natural focus for that eye. When the lens is completely at rest it should focus sharply on the retina objects at a distance of fifty feet. The eye will involuntarily try to neutralize any defect by straining of the ciliary muscles and it is therefore almost impossible to determine accurately the focal distance as long as these muscles are active. So the doctor instills into the eye some drug, such as atropine or scopolamine, which paralyzes for a short time the ciliary muscle and in this way he can make an accurate measurement of the error of refraction. In elderly persons where the eye has lost this focusing power it is not always necessary to use such drugs but in the young it is practically impossible to accurately fit glasses without the use of drugs. For this reason I would warn those of you at least who

have not passed middle life to avoid optometrists who do not use drugs to fit glasses, because there must be a very large element of guesswork in their results.

THE FILM

The third essential for photography is the sensitive film. This is represented in the eye by a structure called the *retina.* The retina is a thin sheet, covering the inner wall of the posterior two-thirds of the eyeball, made up largely of nerve cells. Its organization is extremely complex and I shall not therefore attempt to describe it in detail.

The most unusual elements in the structure of the retina are highly modified nerve cells known as the "rods" and "cones." These

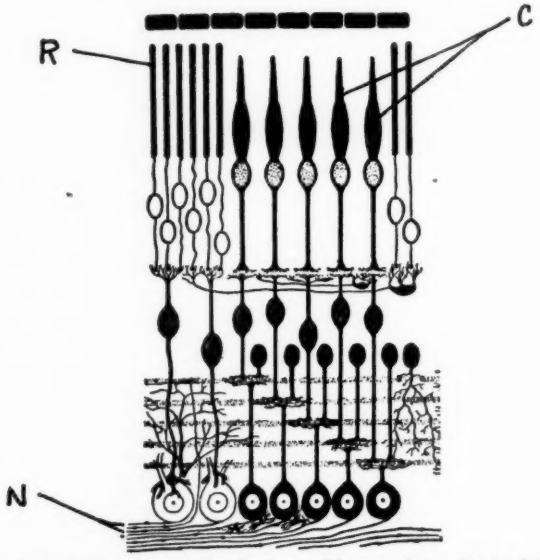


Fig. 7—Microscopical Structure of the Retina. Diagram From Fox's Ophthalmology.

are not equally distributed in the various parts of the retina. Around the edges of the retina the rods predominate but the nearer we come to the center the more numerous becomes the cones. There is a spot straight behind the center of the lens where there are no rods at all, only cones. This is called the *fovea centralis.*

There appears to be a difference in function between the rods and the cones. While the rods are more sensitive—that is they respond to smaller intensities of light—they are not able to perceive objects so sharply. If you look straight ahead you see a small area

clearly, but around this there is a field in which we perceive vaguely that something is there but it is not clearly defined. We say we see it "out of the corner of the eye." This poorly defined field represents the rays of light which fall on a part of the retina where the cones are relatively few.

Because the cones are less sensitive to light when illumination is insufficient we cannot see things sharply. This explains why objects are not seen clearly in dim light and the consequent misinterpretations which are so common at night.

THE DEVELOPER The changes caused by the light falling on the rods and cones are conveyed through the optic nerve to the base of the brain where they are interpreted as objects.

Some years ago I was hunting elk in the Rocky Mountains. Suddenly we heard the whistle of a bull—as loud and shrill as that of a traffic cop—scarcely 50 yards away. The guide said to me, "There he is! Just by that big pine tree." Now the elk is a large animal, some five feet high at the shoulder. I was not blind, I could see the big pine tree; but I could not see that elk, as large as a horse and fifty yards away. It was several minutes before my brain could interpret the picture on my retina accurately enough to pick out the brownish mass of the elk from the shadows of the forest in which he was standing.

Have you never been seeking a certain paper or book amid the litter on your desk and looked straight at it without seeing it? The fault was not in your camera but in your development of the picture.

Show a dog a photograph of his master and he manifests no more interest in the portrait than he does in any piece of paper; but let him smell his master's glove and he recognizes it at once. We have no reason to believe that the dog's eye cannot see the lines on the paper. The reason he does not recognize it is obviously that his brain is not trained to interpret the picture on the retina to mean a man.

One interesting fact, that shows the importance of this interpretive function of the visual centers of the brain, is that the picture thrown on the retina (like that on the film of a camera) is upside down; yet we see it right side up. This power of reversing the image is probably acquired by experience. Watch a young baby try to reach for a bright object and note how its hands go so often in the wrong direction.

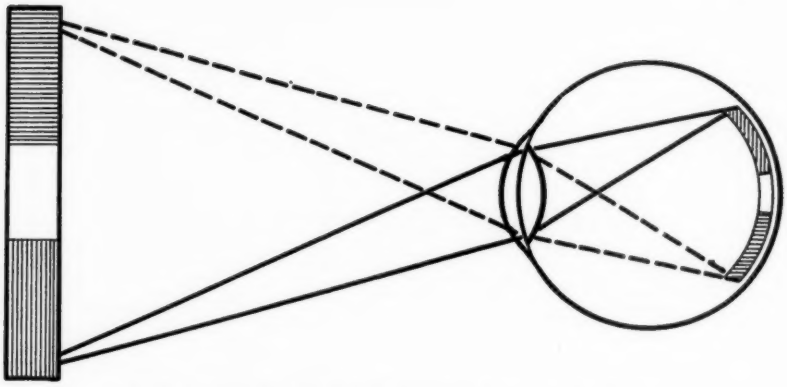


Fig. 8—Diagram to Illustrate Reversal of Image on the Retina.

BINOCULAR VISION

A photograph, no matter how skillfully it is taken, always looks flat. It lacks depth, as the artist says. This is because it is taken only from one point of view. By means of two cameras we can, however, obtain what is called stereoscopic effect, in which objects seem to stand out as if solid. If both of our eyes are working properly we get the same sort of appearance.

The explanation of the stereoscopic effect when using two eyes (or binocular vision) is plain by use of a simple diagram. In Fig. 9

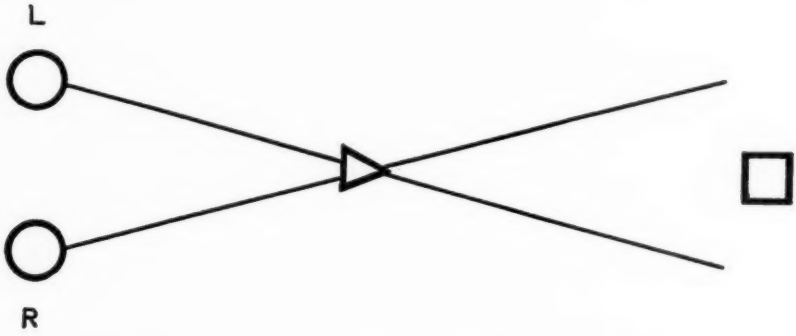


Fig. 9—To Show the Stereoscopic Effect of Binocular Vision.

the square when looked at with the left eye seems to be to the left of the triangle, but to the right eye it is to the right. Our brain therefore reasons that the triangle is nearer to the eye than the square.

How important in our daily occupations is this binocular vision is shown by the familiar experiment of trying to thread a needle with one eye closed.

It is obvious that if we look at an object with both eyes, as it comes nearer our eyes must be pointed more and more inwards—converged—until, when it is very close, we get the same appearance as "cross-eyed."

The judgment of distance, or the perception of death, is largely, but not solely, due to binocular vision. Other factors which aid are the relative size of objects when near and far, the unperceived lines of perspective (as the sides of a building), the changing tension on our eye muscles, the relative rate of movement of objects compared to each other, etc. All of these factors are, after all, functions of the intellect rather than of the eye. And so we come back to our original proposition that we see with our brains.

THE TINCTURES OF CINCHONA
(Third Paper)
A Preliminary Report
THE ACETONE EXTRACT FROM CINCHONA BARK AND ITS RELATION TO THE STABILITY OF TINCTURES OF CINCHONA

By Aaron Lichtin, Ph. G.

I. Introductory Remarks

In a previous paper on "The Tinctures of Cinchona," [1] reference was made to a preliminary examination of an acetone extracted substance from cinchona bark. It was described as a tarry looking substance completely soluble in hot and but very slowly soluble in cold alcohol. The alcoholic solutions are acid to litmus; green colored complexes and precipitates are obtained with ferric chloride solution; gelatin is precipitated and the alcoholic solutions act as alkaloidal precipitants.

In another paper [2] on "The Tinctures of Cinchona," which dealt with the compound tincture, an acetone extract was obtained from red cinchona bark which behaved similarly to the one obtained from the calisaya bark. Five hundred grams of red cinchona bark yielded thirty grams of this extract.

The object of this paper is to report in some detail the chemical behavior of the acetone extracted material.

II. Experimental

1.

The thirty grams of the dried acetone extract referred to above were dissolved in alcohol and filtered. A small quantity of a green oily substance resembling chlorophyll was left on the filter paper. The filtrate was distilled in a partial vacuum to a syrupy consistence and to this was added 500 cc. of distilled water in several portions, shaking the contents of the distilling flask after each addition. A voluminous precipitate appeared which was filtered on a suction filter, washed with distilled water until the washings were practically free

[1] The Tinctures of Cinchona, First Paper, *A. J. P.*, Vol. 102, October, 1930, p. 589.

[2] The Tinctures of Cinchona, Second Paper, *A. J. P.*, Vol. 103, May, 1931, p. 279.

from color, dried first on the filter paper and then on a water bath. The resulting dry powder was amorphous, dull, dark brown in color, possessing an odor characteristic of cinchona bark and did not exhibit the glossy appearance and fracture of a tannin. The yield was 3.87 grams.

This powder will subsequently be referred to as component A.

The filtrate (without the washings) was concentrated to a small bulk in a partial vacuum and shaken out in a separator with several portions of ethyl acetate until it became difficult to get a further separation. The ethyl acetate solution was filtered and concentrated in a partial vacuum to a small bulk and dried on a water bath at about 75 degrees C. to 85 degrees C. While drying, it exhibited the typical puffing of a tannin. The final product was of a varnishlike appearance and resinous fracture. When the material was powdered, it appeared light yellow in color, odorless and somewhat hygroscopic. The yield was 6.9 grams.

This product will subsequently be referred to as component B.

The aqueous residue was filtered and dried on a water bath. It appeared dark brown in color, had an odor of burnt sugar and was rather hygroscopic. The yield was 2.7 grams.

This product will subsequently be referred to as component C.

Though the three components were separated through differences in solubility it was observed that they are soluble to a great extent in the same solvent. Component A dissolves slowly and partially in water, more rapidly in 64 per cent. and 78 per cent. alcohol (menstrua employed in experimenting with tinctures of cinchona); component B dissolves in water and in 64 per cent. and 78 per cent. alcohol; component C is soluble in alcohol (64 per cent. and 78 per cent.) and ethyl acetate. All solutions were 5 per cent. $\frac{w}{v}$.

2

Component A

Due to its ready solubility in ammonia water (10 per cent.) and other dilute alkali solutions such as KOH and NaOH forming a red-colored solution and also due to its solubility in cold alcohol, component A is evidently the phlobaphene or phlobotannin of the bark. Phlobaphene, according to Tschirch,[3] exist in dead cinchona

[3] The Phlobaphenes: Dittmar Moritz, *J. A. Ph. A.*, August, 1923, p. 682.

bark having resulted from the oxidation—while in the membranes—of the prototannids from the cell contents. It was observed that phlobaphene was largely responsible for the colored coating on the inner walls of containers of tincture of cinchona as well as for the darkening of the preparation. The phlobaphene solutions had material adhering to the inner sides of the containers and darkened on standing much more rapidly than the other solutions. In fact, in the latter solutions several weeks were required for their darkening as well as for the appearance of a colored coating, while in the phlobaphene solutions both these characteristics were revealed within a few days. This phenomenon can be explained by the fact that the alkali in the glass containers acting on the phlobaphene result in the production of adhering material and darkening of solutions, reactions characteristic of interaction of alkalies on phlobaphenes. Alkali-free containers of tinctures made with neutral menstrua and kept at room or higher temperature though revealing sediments do not show colored material adhering to the inner sides of the containers and do not reveal a darkening of the solution. Tinctures similarly stored in the cold (about 40 degrees F.) show a slight film on the inner walls of containers.

Phlobaphene solution is acid to litmus, reacts weakly with solutions of iron salts, becomes turbid very slowly with gelatin solution, gives a flesh-color precipitate with bromine water, yields immediately a red color on addition of ammonia water, which fades on standing and precipitates alkaloids. It reacts with permanganate solution yielding a heavy brown precipitate and clear supernatant liquid, is absorbed by hide powder, is rather resistant to acid hydrolysis and of the three components yields the least quantity of CuO when acted upon by Fehling's solution.

For a summary of its behavior towards various reagents see Table VI.

3

Component B

Component B responds physically to a description of cinchotannic acid.[4] It is a light yellow somewhat hygroscopic substance soluble in water, the solution being acid to litmus. With iron chloride and acetate solutions its solution gives a green color and precipitate

[4] Thorpe, Edward: *Dictionary of Applied Chemistry*, Vol. VI, p. 664, 1926.

more quickly than with component A. In fact, the reaction is immediate. In this respect as well as its precipitating effect with gelatin solution component B exhibits the strongest tendency of the three components. It yields heavier precipitates and more quickly. A red precipitate is produced with bromine water. Ammonia water added to a solution of component B gives a crimson color which becomes intensified on standing then turning orange brown. This substance is not as marked an alkaloidal precipitant as component A. It changes the color of potassium permanganate solution but does not form a precipitate; it is absorbed by hide powder, is not as resistant to acid hydrolysis as is phlobaphene and yields a larger quantity of CuO when acted upon by Fehling's solution.

For a summary of its behavior towards various reagents see Table VI.

4

COMPONENT C

This substance exhibited the least chemical activity with the various reagents used. A solution of this component gives colors with solutions of ferric chloride and ferric acetate but no precipitate, gelatin solution reacts with it very slowly and bromine water gives a yellowish precipitate. With potassium permanganate solution a heavy brown precipitate is formed and acid hydrolysis almost completely changes it into substances which reduce Fehling's solution, thus yielding the largest quantity of CuO when acted upon by the latter reagent. Component C is absorbed by hide powder and the clear filtrate reacts with Meyer's reagent and picric acid solution. Both reagents cause a turbidity at first and then a precipitate after standing several days.

It is significant to note that of the three components this is the only one that gives a positive reaction for alkaloids after absorption by hide powder.

For a summary of its behavior towards various reagents see Table VI.

5

TECHNIQUES EMPLOYED

a. Acid Hydrolysis [5]

0.2 gram of substance was boiled in a small flask with 50 cc. 0.2 per cent. hydrochloric acid under an upright condenser for two

[5] The Tannins, Henry Trimble, Vol. 1, 1892.

TABLE VI

Showing action of various reagents on components A, B, C; dilution 1:2000 except where otherwise indicated.

Reagent	*Component A*	*Component B*	*Component C*
Sol'n Ferric Acetate	Greenish brown sol'n	Bluish green sol'n at first; turns muddy brown and precipitates leaving colorless supernatant liquid	Greenish brown solution
Sol'n Ferric Chloride	Brown ppt.; greenish supernatant liquid	Green solution, turning rusty brown. Precipitates on standing, leaving greenish brown liquid	Clear green solution
Gelatin solution	Turbidity (1:400)	Turbidity; ppt. on standing (1:200)	Turbidity, then ppt. on standing (1:200)
Ammonia (10%)	Crimson color at once; fades on standing	Crimson color, becoming intensified on standing; then turning orange brown	No change
H_2SO_4 concent.	Light brown ppt.	Light brown ppt. on long standing	Very slight crimson ppt. on long standing
Bromine Water	Flesh colored ppt.	Crimson ppt.	Yellow ppt.
HCl concent.	Orange-yellow ppt.	No change	Very slight orange—yellow ppt. on long standing
Meyer's reagent	No change	No change	Pink ppt. supernatant liquid colorless
Nitric Acid concent.	Yellow ppt.	No change	No change
Sol'n Quinine bisulph.	Crimson ppt.	Slight reddish brown ppt.	Slight brown ppt.
Tannic Acid (1%)	Light brown ppt.	Light brown ppt.	Light brown ppt.
Millon's reagent	Brownish red ppt.	Brownish red ppt.	Brownish red ppt.
Acetic Acid	Slight yellow ppt.	No change	No change
Pot. Permanganate Solution	Heavy brown ppt. supernatant liquid clear	Brownish red color; no ppt.	Heavy brown ppt.

TABLE VII

Showing results of acid hydrolysis.

0.2 gram Component A leaves 150 mgm. on hydrolysis.
0.2 gram Component B leaves 45 mgm. on hydrolysis.
0.2 gram Component C leaves 20 mgm. on hydrolysis.

TABLE VIII

Showing determination of reducing substances (sugars?).

0.2 gram Component A yields 55 mgm. CuO.
0.2 gram Component B yields 145 mgm. CuO.
0.2 gram Component C yields 150 mgm. CuO.

hours. After cooling the liquid was filtered on a tared filter paper, which was afterwards dried to a constant weight. The weight of the unhydrolyzed material was noted, while the clear liquid was reserved for the determination of reducing substances (sugars?).

b. Determination of Reducing Substances[6] *(Sugars?)*

The clear liquid obtained in *"a"* was neutralized with sodium carbonate. A sufficient quantity of 10 per cent. lead acetate solution was then added until no further precipitate could be obtained and filtered. This was done by adding the lead acetate solution in 5 cc. portions, filtering a small quantity of the liquid and adding several drops of reagent to the clear liquid which was afterwards returned to its source. To the clear filtered liquid about 5 cc. sulphuric acid (1:4) was added to free it from lead, and filtered. The clear liquid was neutralized with sodium carbonate. Ten cc. of Fehling's solution were then added to it and allowed to boil slowly about a half hour. After cooling the liquid was filtered on a tared filter paper which was then dried to a constant weight and the weight of the residue was noted.

c. Hide Powder Absorption

Five cc. each of 0.5 per cent. solution of components A, B and C were mixed with 5 cc. distilled water and triturated in a mortar with 0.2 gram hide powder. The solution of component A was warmed before trituration to expel the alcohol which was replaced with distilled water. The three mixtures were allowed to stand overnight and filtered. The clear liquids gave no reaction for tannin with iron salts or gelatin solution. A and B did not react with Meyer's reagent or picric acid solution (alkaloids), while C at first showed a turbidity and then a precipitate on standing. Thus the tannin and alkaloidal reactions of this component do not apparently reside in the same substance.

III. Conclusions and Comments

A study of the acetone extract from cinchona bark has been presented from the standpoint of its significance in the keeping qualities of cinchona tinctures. There is no doubt that the tannins obtained in the acetone extract play an important part if not the leading part in the precipitation and discoloration of the tinctures. *A tincture of cinchona prepared by the writer from acetone treated*

[6] The Tannins, Henry Trimble, Vol. 1, 1892.

bark and kept in an alkali-free bottle (pyrex) shows no precipitate, discoloration or adhering material on the inner sides of the container after standing for over a period of one year.

Three components have been obtained from this extract, each differing in certain properties from the other.

The fact that component C shows an alkaloidal reaction after its tannin is absorbed by hide powder seems to be significant. Is this component the natural combination of alkaloids and tannin in the bark or is it a physical attachment? It is hoped some light might be shed on this phenomenon in the future.

The hydrolysis experiments are significant and instructive. Determination of hydrolyzable material may be of value for obtaining the *quality* of a tincture of cinchona aside from its *strength.* The more hydrolyzable tannins in a tincture or other liquid preparation of cinchona the greater will be the sedimentation and discoloration. As is, from experiments reported in this paper it is observed that the acetone extracts a large portion of hydrolyzable tannins from the cinchona bark. This will account for the better keeping qualities of tinctures of cinchona made from acetone treated bark.

A tincture relatively rich in hydrolyzable tannins should yield a large quantity of hydrolyzable material as well as a considerable quantity of reducing substances (sugars?), while a tincture lacking in hydrolyzable tannins should yield relatively smaller quantities of hydrolyzable material as well as a smaller quantity of reducing substances (sugars?).

Thus, while alkaloidal strength indicates *strength of the tincture* hydrolysis would indicate *relative stability.*

Preliminary experiments with tinctures of cinchona made with different menstrua reveal that there does exist a relationship between the hydrolyzable tannins and the keeping qualities of these tinctures. Further research is being conducted with the various tinctures of cinchona along these lines as well as the relationship which may exist between the quantity of reducing substances in these preparations and the quality of the latter. The preliminary findings and other reports dealing with these relationships in tinctures of cinchona will follow in another paper.

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THE DETECTION OF COCAINE IN THE PRESENCE OF NOVOCAINE BY MEANS OF COBALT THIOCYANATE

By James L. Young*

The analyst who is engaged in the enforcement work in connection with the "Harrison Narcotic Act," and similar laws, is frequently confronted with the analysis of mixtures containing the salts of cocaine and novocaine.

These substances, unfortunately, from the chemist's standpoint, are soluble in the same solvents and their separation by extraction is virtually an impossibility. Likewise a mixture of their salts gives various shaped crystalline precipitates with platinum chloride and other reagents, depending upon the percentage composition of the mixture as well as upon the concentration of the solution. The microchemical reactions usually employed, which depend upon definite crystalline compounds, are, therefore, equally unsatisfactory.

Method

The hydrochlorides of both cocaine and novocaine form blue precipitates with a solution of cobalt thiocyanate, the latter, however, being soluble in a solution of stannous chloride.

Two solutions are necessary for the test.

First: A 2 per cent. aqueous solution of cobalt thiocyanate.

Second: A freshly prepared acid solution of stannous chloride, containing an excess of tin, which should be filtered before using. To ten grams of stannous chloride in 100 cc. 1 : 1 HCl add five grams of mossy tin.

Procedure

Note—(If a solution, evaporate to dryness.)

Place a small quantity of the salt under examination in one of the depressions of a spot plate or in an evaporating dish. Now add four or five drops of the cobalt thiocyanate solution. If cocaine alone is present, Prussian blue colored flakes will form. If novocaine or a mixture of novocaine and cocaine is present, the entire solution will become blue.

Now add four or five drops of the stannous chloride solution and stir gently with a glass rod. If novocaine only is present the

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precipitate is immediately dissolved, leaving a pink solution. If cocaine only is present, no perceptible change is apparent. If both novocaine and cocaine are present, the former dissolves, while the latter remains in the form of blue flakes or streaks which may adhere to the glass rod or to the spot plate.

Interfering Substances

Milk sugar and acetanilid, the two adulterants most frequently used by the "dope peddler," in no wise interfere with the reactions. The same is true of morphine salts and ecgonine. On the other hand the salts of codeine and diacetylmorphine, if shown to be present in the unknown by means of a preliminary formaldehyde sulphuric reaction, must first be removed.

FUNGOUS FRIENDS AND FOES

By Marin S. Dunn, Ph. D.

WHEN we glance at charts showing man's attempt to classify the plants he has found in the world about him in such a way as to show as nearly as possible the natural relationships among the various groups, we find that, as a general rule, there are recorded four large divisions. The lowest of these, embracing a vast assemblage of the most primitive forms of plant life is the division Thallophyta.

Marin S. Dunn, Ph. D.

The members of this division are strikingly different from the plants that we are commonly acquainted with—the ferns and the seed-bearing plants. When we think of a plant, we usually visualize it in terms of an organism possessing roots, stems and leaves, and we think of it with respect to the attractiveness of its foliage or in terms of some other outstanding characteristic.

What is our surprise, therefore, to learn that Thallophyte plants do not show the parts above-mentioned which are found in the higher forms of plant life! Instead, the vegetative body of the plant—known as the thallus—is not differentiated into roots, stems and leaves. In some cases, the thallus consists of a single cell, while in others, a multitude of cells make up the plant body (Figs. 1, 2, 3 and 5). In addition, there are no groups of fibers, vessels and cells conveying crude and elaborated sap—known as vascular bundles—such as we find in the plants belonging to the higher divisions of the plant kingdom. And yet as we shall presently see, the plant, no matter what its complexity, possesses the properties of all living organisms—obtaining and utilizing food, responding to stimuli, growing in a definite way, and reproducing its own kind.

Scientific classifications of the Thallophyta are in part natural and in part artificial due to our lack of knowledge, and it lies within the realm of our systematic botanists to add to our knowledge in such a way that classifications of the future may more easily approach the truly natural. In our talk, set forth by this paper, we need not be concerned to any great extent with the various systems of classifi-

cation proposed by different investigators. Sufficient it is to say that to the Thallophyta belong the slime molds, the bacteria, the algae (blue-green, green, diatoms, brown and red), the fungi and the lichens. Although some authors include the bacteria and slime molds as classes of fungi, we are only concerned with that assemblage of plants known as the True Fungi or Eumycetes, and the rest of this talk will be devoted to a discussion of this group.

GLOSSARY Scientific terms have been eliminated in this article as far as possible, but there are several which it was found desirable and necessary to use. Most of these are assembled here for convenience and defined, and they are again explained as they appear in the text.

Ascospore = a sexually produced spore developed in the sac or ascus of a Sac-Fungus.

Ascus = spore case or sac of a Sac-Fungus (Fig. 4).

Basidiospore = spore produced by the swollen end of a hypha of a Club-Fungus (Fig. 5, No. 7).

Basidium = swollen end of a hypha of a Club-Fungus which produces spores on the outside (Fig. 5).

Cell = mass of living matter containing a denser region known as the nucleus.

Enzyme = a substance of biological origin and sensitive to heat which alters the rate of chemical reactions without being used up itself.

Hypha = a hairlike thread of a fungus (Fig. 1).

Mycelium = vegetative body of a fungus composed of a mass of hyphae (Figs. 1, 3).

Nutrient medium = a substance upon which a fungus (in this paper) may grow and obtain food. When green mold grows on jelly, jelly is the nutrient medium.

Parasite = a plant or animal living upon and deriving food from another living organism (host).

Saprophyte = a plant or animal living on or inside of dead organisms or decaying organic material, such as leaf-mold and obtaining nourishment therefrom.

Spore = a tiny cell of value in the dissemination and propagation of a species (Fig. 3).

Thallophyta = the lowest of the four divisions into which the plant kingdom may be divided.

Thallus = a plant body which is not organized into roots, stems and leaves as, for example, the mycelium of a fungus (Figs. 1, 3).

Zygospore = the sexually formed cell which is the result of the union of two similar sexual cells.

BOOKS Good reference and textbooks are excellent companions and invaluable aids in the study of any subject, and in the case of fungi, the above rule is no exception. The following will be of great assistance in helping the interested student to understand plant life with particular reference to fungi. Certain citations in the following list are general textbooks of botany, but the subject matter relating to fungi is clear, concise and interesting.

Duggar, B. M.—Fungous Diseases of Plants.
Fitzpatrick, H. M.—The Lower Fungi.
Gager, C. S.—General Botany.
Harshberger, J. W.—Mycology and Plant Pathology.
Holman, R. M., and W. W. Robbins—General Botany.
Marshal, N. L.—Mushroom Book. (Containing colored plates.)
Massee, G.—British Fungi. (Containing colored plates.)
Youngken, H. W.—Pharmaceutical Botany.

TRUE FUNGI Most of us have first-hand knowledge of some members of this class although we may not have previously realized just where they might be classified. Who has not seen the blackish, cobwebby net that forms on the outside of moist bread when exposed to the air for a sufficient time, or who has not noted the greenish stain covering the surface of decaying oranges? Again in this day and age when we hear so much talk of vitamins, who has not heard of yeast? When we go to our restaurant and order our steak, do we not count on the liberal supply of mushrooms as an extra factor in its palatability? The cases cited are all common examples of fungi affecting our daily lives. But fungi play a far greater rôle than this as we shall see in the next few pages.

FOES OF MAN Many fungi, by growing upon, damaging or destroying (or both) our cultivated plants, produce serious economic loss for us as a nation causing the yearly expenditure of an enormous amount of labor and great sums of money. To mention a few of the well-known diseases of crop plants for which fungi are responsible, it is only necessary to refer to such common forms as apple scab, black rot of grapes, brown rot of plums and peaches,

peach leaf curl, mildews, rusts and smuts of cereals and anthracnose of bean. Bailey (2) states, "The loss from scab in the apple crop of New York State often totals not less than $3,000,000 and for the United States a corresponding loss of over $40,000,000. In 1900, the peach-growers of Georgia lost $5,000,000 by brown rot, while the average annual loss from the same disease in the entire United States is never less." And these are only two of the many statistics which might be quoted.

The Check List of Diseases of Economic Plants in the United States issued by the United States Department of Agriculture in 1926 (1) is a formidable one—cataloguing many hundreds of fungi and the hosts upon which they produce their havoc. In nearly all cases, a single host plant may have more than one fungus attack it, and often there are many against which it must be protected. This alone would warrant widespread public interest and attention.

It is no wonder, therefore, that man is intensively studying the various fungi which affect him in his endeavor to conquer scientifically their attack. To quote from Duggar (3) "A proper knowledge of the life histories of parasitic fungi, experience in the use of spray mixtures, an adequate conception of crop requirements, and a comprehension of general plant physiology make possible in the great majority of cases a rational means of disease control.

"Eradication, prevention or control of fungous diseases may be brought about more or less successfully by proper regard for such factors as varietal resistance, seed selection, crop rotation, seed treatment, application of fungicides to the growing crop, and general sanitation. It is frequently necessary to combine several methods of procedure in combating the attacks of a single organism, and in no case should practices of general sanitation be disregarded." By a judicious selection of fungus-resistant varieties, much harm may be avoided since it is known that often closely related varieties may be very different in their susceptibility to a given disease. Likewise in those cases in which the disease infects the seeds such as bean anthracnose, selection of disease-free seeds may bring about control. In cases where the ground becomes the breeding place of the fungus, it is often advisable to alter the character of the crop plant so that the fungus finding itself without a host will, in time, die.

Various chemical compounds, applied as sprays, are used in order to protect plants against fungal infection, but it should be

observed that as far as possible, these compounds should not have the nature or strength to harm the plants they are intended to protect. In the applications of fungicides, it is necessary to study not only the nature and reactions of the host plant which vary from time to time, but also to have intimate knowledge of the fungus against which they are used. The following is a list of some of the more important fungicides together with notes upon their application.

(a) Bordeaux Mixture.

A standard mixture (known as 5-5-50) is given as follows and this may be increased or decreased in strength according to the circumstances.

Copper sulphate	5 lbs.
Stone lime	5 lbs.
Water	50 gals.

Bordeaux mixture is a good standard spray although in some cases its harmful effects preclude its use, as in the case of peaches, plums and apples. It may discolor marketable fruits and ornamental foliage.

(b) Ammonical Copper Carbonate.

This may be used in place of Bordeaux mixture when discoloration of foliage is not desired.

Copper carbonate	5 ozs.
Ammonia (26° Baumé)	3 pts.
Water	50 gals.

(c) Lime-Sulphur Wash.

There are different forms of this wash, such as the self-cooked, which is often employed. For details consult Duggar (3) and Harshberger (6).

Flowers of sulphur	10 lbs.
Stone lime	10 lbs.
Water	50 gals.

This is becoming increasingly more important in the control of many plant diseases.

(d) Potassium Sulphide.

This is thought to be especially beneficial in preventing certain mildews, and it does not discolor foliage.

Potassium sulphide	3-5 ozs.
Water	10 gals.

(e) Flowers of Sulphur.

This is often effective when dusted over plants, especially when they are wet, to prevent certain mildews such as occur on the rose.

In some cases, seeds are treated by means of chemicals to kill disease-producing fungi. In the case of certain important cereal diseases, this is the only known method of substantially decreasing the losses. The United States Department of Agriculture (12) has carried on numerous experiments on seed treatment of farm plants using among other things, copper carbonate, hot water, formaldehyde and mercuric chloride. As these chemicals are poisonous with the exception of hot water, care must be taken in handling them. Those interested should obtain from the United States Department of Agriculture, Bureau of Plant Industry, Miscellaneous Publication No. 94, Washington, 1930 (12), in which the crop, disease, name, quantity, strength or temperature of the disinfectant together with the duration of treatment and remarks are listed. For a more detailed account of fungicides in general and their preparation, the reader is referred to "Fungous Diseases of Plants" by Duggar (3), and "The Standard Cyclopedia of Horticulture," by L. H. Bailey (2).

Thus it may be seen that the study of any given plant disease is a complicated subject and demands the earnest attention and thought of the investigator whose ability to diagnose the disease and prescribe the treatment lies in a thorough study of existing conditions, together with knowledge of the structure, physiology and life history of host and parasite alike. And as in the case of human suffering caused by disease, an ounce of prevention is worth a pound of cure.

The following list is added to give some idea of the range of plants which are parasitized by various fungi, and the examples have been selected to show different types of treatment. For more specific directions as to strength of spray, when to apply it, and also for a more detailed list of host plants, see Bailey (2), Duggar (3), or "Mycology and Plant Pathology" by John Harshberger (6).

Name of Host	*Name of Disease*	*Control*
Fir	Witches' Broom	Prune off affected parts.
Maple	Tar Spot	Burn all old leaves in fall or winter.
Apple	Scab	Burn old leaves in spring. Spray correctly with lime-sulphur, 1-40, 32° Baumé.
Asparagus	Rust	Dust with flowers of sulphur every three weeks in the morning.
Bean	Anthracnose	Use seeds from pods without spots.
Beet	Heart Rot	Destroy affected plants; practice long rotations.
Carnation	Rust	Spray once in two weeks with solution of copper sulphate, 1 lb. to 20 gals. of water. Pick off diseased leaves.
Cherry	Brown Rot	Judicious spraying with lime-sulphur or Bordeaux mixture of proper strength.
Chestnut	Canker	Remove diseased parts and paint wounds.
Gooseberry	Mildew	Spray with potassium sulphide of correct strength at intervals.
Peach	Blight	Lime-sulphur or Bordeaux mixture of proper strength.
Peach	Leaf-Curl	Lime-sulphur of proper strength.
Peach	Yellows	Burn affected trees.
Plum	Black Knot	Burn parasitized parts in the autumn or the whole plant if badly affected.
Potato	Scab	Keep lime and ashes from the soil. Use formalin, one pint to 30 gals. of water to soak tubers for two hours. Avoid planting in infected soil.
Radish	White "Rust" or Mildew	Steam sterilize soil before planting.
Tobacco	Root Rot	Steam sterilization of seed bed.
Watermelon	Wilt	Resistant varieties should be used.

Although a great many fungi attack the higher plants, relatively few are known to parasitize higher animal life including man. However, there are some examples on record of the latter which may be brought forward at this time. Aspergillus niger or more properly Sterigmatocystis niger has been found to produce inflammation of the outer and middle ear of man, and Aspergillus fumigatus may attack the lungs of birds, cattle, and rarely man, producing a disease known as Aspergillosis. In this disease the fungus is found abundantly in the sputum. A case has been described by Paltauf in which a member of the genus Mucor was found in abscesses in the lungs, brain and body cavity.

Ringworm is not produced by a worm at all but is probably caused by various fungi such as Trichophyton sp. which grow abundantly in and under the epidermis causing a chronic inflammation. They invade the hair follicles and the hairs themselves—the latter becoming brittle, breaking off or dropping out. Infection may be spread by the barber's razor as the disease is easily transmissible.

The fungus, Achorion, which produces the disease known as Favus, is another example which may be cited. Favus commonly occurs on the body, such as the scalp, although it may grow on hairless areas and nails. Favus, itself, may be described as a dry, yellowish honeycomb-like incrustation. McFarland (11) states "The disease runs a course sometimes extending over many years. Crocker mentions a case that recovered after thirteen years. It may remain localized upon the scalp or may spread itself over the skin surface. When the lesions are large they give off an odor suggesting that peculiar to white mice. In recovering, the lesions leave considerable cicatricial scarring, and atrophy of hair-follicles sweat, and sebaceous glands is inevitable." In the United States, it often occurs on immigrants coming from certain parts of southern and eastern Europe.

A case of generalized infection was discovered by Busse which ended fatally and which was caused by a plant organism—apparently a yeast. The study of yeasts is very complicated. There are numerous kinds, many of which are utilized by man to contribute to his welfare, but as often happens in the best regulated families, there occurs from our point of view the inevitable black sheep which works for our destruction rather than our good. It seems to be just such an example that Busse had run across. It was found through post mortem examination that the yeast was present in the abscesses occurring in the tibia, ulna, rib and in the lungs, kidney and spleen

(8). Examples of a well-defined skin disease, first called attention to and described by Gilchrist some years ago are ascribed to a similar yeast-like organism. The disease may follow a fairly uniform course. The first indication is a small pimple on the arm, face, etc., which produces viscid pus. As the lesion heals, other areas of pus formation occur at the outside so that the disease, though healing in part, is spreading. A number of cases of infection by yeast-like organisms is now on record.

The disease known as thrush occasionally found in the mouths of infants is an infection of the mucous membrane, and creamy-white patches of fungous growth may be seen on the surface attacked. The cells of the fungus are yeast-like in appearance.

For one having time and opportunity, the study of the fungi producing diseases in man might yield gratifying returns since the literature is often confusing and misleading and we must know much more concerning these pathogens.

Certain fungi are of economic importance since they produce poisoning if eaten. Ergot is one of these. In parts of Europe, cases of ergot poisoning occur among the poorer people who eat bread made from rye flour containing ergot. Among the signs are gangrenous conditions of the extremities with a loss of nails, teeth and hair. Amanita phalloides, the death cup, is our most deadly toadstool (there is no botanical distinction between mushroom and toadstool) which is found growing in woods and along borders of fields. It contains a poisonous substance which destroys the blood corpuscles.

FRIENDS

Now let us look carefully at the other side of the picture—namely how certain fungi are beneficial to man.

Ergota U. S. P. which is an important drug used as a parturient (in certain stages of labor) and hemostatic (in uterine hemorrhage) is the body developed on the rye plant by a certain fungus, Claviceps purpurea, during a part of its life history. Later, we shall follow the entire life cycle of this fungus, but the point to be emphasized at this time is its importance to the medical profession. Agaricus N. F. is the dried fruit body of the fungus Polyporus officinalis Fries found on species of pines, larches and spruces and is used as an anhydrotic in sweats of wasting diseases such as pulmonary tuberculosis. Another species, Polyporus fomentarius (L.) Fries found on

oaks and beeches in European countries has been employed because of its styptic properties in external hemorrhages (18).

There are many different kinds of yeasts. The ordinary cultivated beer yeast fungus, Saccharomyces cerevisiae is a prominent source of vitamin B which promotes growth by stimulating metabolic processes. It may be used in medicine also for the treatment of boils, certain skin eruptions and as a laxative. Under the name, Cerevisiae Fermentum Compressum, the moist living cells of Saccharomyces cerevisiae Meyen or other species of Saccharomyces are official in the N. F.

We are all familiar with the use of yeast as a leavener in the baking of bread—the carbon dioxide produced causing the dough to rise and become light.

Of course, in the brewing industry, beer yeast finds a great application since it is capable of developing during growth on sugar solutions considerable quantities of alcohol. The general change taking place in glucose solutions through the activities of yeast may be shown as follows:

Glucose ($C_6H_{12}O_6$) = Alcohol (C_2H_5OH) and Carbon Dioxide (CO_2). Cane sugar $C_{12}H_{22}O_{11}$ can be fermented by many yeasts since they are able through enzymatic action to first change the more complex sugar into glucose and fructose. A number of races of the beer yeast exist which may be separated into two groups: the first containing those forms which grow on or near the top of the liquid, producing abundant CO_2 and consequently frothing such as we find in porter and ale; the other group or bottom yeasts which are found deep in the fermenting liquid and which are used in the manufacture of lager beers.

The wild wine yeast, Saccharomyces ellipsoideus is found on the skin of the grape and is important in the fermentation of grape juice since it finds its way into the liquid from the skin. The flavor of the wine seems to owe its nature to the variety of wine yeast used, and different grape-growing regions appear to have their particular form of wine yeast.

According to Harshberger (6) the "organisms of Kefir are Saccharomyces cartilaginosus and S. fragilis. Kefir is a beverage prepared originally in the Caucasus region by fermenting milk. Kefir grains, which include the above yeasts, a Torula, and three bacteria (Bacillus caucasicus, etc.) are added to the milk as a starter. The

fermentation of the milk results in the formation of alcohol, lactic acid and carbonic acid."

In alcohol fermentation by yeasts, glycerine has been recognized, for a long time, as one of the by-products. By scientifically manipulating the process, however, glycerine may become the main product.

Various species of the green molds, Penicillium and Aspergillus, are useful in industry, based upon their yielding desirable products, when grown on a suitable culture medium and under controlled conditions.

One of these fermentations results in the production of gluconic acid (whose calcium salt is proving of value in calcium therapy) from the sugar, dextrose or glucose. May, Herrick, Thom and Church find that a number of Aspergilli and Penicillia yield more or less gluconic acid and from their studies, select the form they call Penicillium luteum-purpurogenum var. rubrisclerotium. A 25 per cent. glucose solution was found to yield the best results in acid production (14).

Many molds when growing upon a suitable carbohydrate medium will cause the production of citric and other organic acids. In 1928, two patents were taken out in the United States for the production of citric acid: the one employed species of Mucor, Citromyces, Aspergillus and Penicillium growing on a molasses base; the other used dark-colored Aspergilli.

Diatase, an enzyme having the power of changing starch into maltose, used for example in the textile industry for degumming silk, and removing the excess size from woven fabrics (14), is produced by certain organisms, among them being Aspergillus oryzae, A. niger and Penicillium glaucum.

Penicillium roqueforti is instrumental in the ripening of Roquefort, Gorgonzola and Stilton cheeses, and P. camemberti plays a similar rôle for Camembert cheese.

We must not overlook at this time the food value of some of our fungi which makes them an acceptable article on our bill of fare. It must be stated here and repeated again that we should not gather and eat fungi such as the mushrooms unless we have absolute knowledge of the plants gathered. Certain of the higher mushrooms are extremely poisonous and it does not pay to take chances where uncertainty exists. The old sayings that "if a silver spoon, placed along with the fungi when cooking turns black, it is a sign that such fungi are poisonous" and "all fungi having a skin that can be peeled

off the cap, as in the common mushroom, are edible" are incorrect (10). There is only one rule to follow: learn to know fungi correctly and do not eat them before that time arrives when you are sure of your knowledge. Rather than take a chance, consult one experienced in such matters. It must be noted that there are many edible fungi beside the common meadow mushroom, Agaricus campestris, and many of them have their own particular flavors and render diets more palatable. We do not primarily eat mushrooms in order to gain sustenance since it has been found that the amount of nitrogenous material that is actually used by the body as food is very small and that "fungi practically contain no more flesh-forming material than a cabbage does" (10).

The following receipts are selected from the volume on Mushrooms by Marshall (9) in the Nature Library:

> "To Keep Mushrooms Temporarily.—Cleanse, remove the parts to be rejected, rinse in cold water the parts to be used, dry with a cloth, then put in boiling water and keep boiling for five or ten minutes. Drain and wipe dry."
>
> "To Prepare the Edible Agarics for Cooking.—Cleanse, cut off the stems and throw them away. Rinse the caps in cold water, drain, and leave in cold water acidulated with lemon or vinegar until just before using."

By turning to the same reference given above, page 153, we may find receipts for toasting, baking, broiling and stewing agarics together with directions for using various other edible fungi such as the Russulas, morels, Clavarias, puffballs, etc.

With respect to the valued delicacy known as truffles, it is interesting to relate something of the manner in which they are collected. Certain species of the Genus Tuber grow in the deciduous woods of northern Italy, Germany and France and produce tuberous underground bodies called trúffles. These have a peculiar odor of their own and are smelled out by trained dogs and pigs employed by truffle hunters. They are dug up and conveyed to places where they are packed in labelled tin cans ready for shipment.

Time will only permit us to mention the important rôle played by certain soil fungi in aiding in the decay of organic matter such as dead branches and leaves with the resultant formation of humus, a substance of great agricultural importance. In certain cases, also, fungal hyphae may form associations with the roots of higher plants

(beech, etc.). So important may be this relationship that the higher plant may die if transplanted in a soil devoid of the fungus. The fungal threads aid the roots in the taking in of nutrient substances from the ground.

Thus we have endeavored to review briefly in the preceding pages, the more important ways in which fungi prove harmful or useful to man. The list is by no means complete, but anyone interested may easily amplify his studies by reference to any of the more specialized texts on the subject. The rest of this paper will be devoted chiefly to a discussion of the structure, physiology and life histories of certain economic forms, representing the important classes of fungi. Having learned that they play a considerable part in our lives, it now behooves us to study certain members at closer range, and through them, to gain a more sympathetic appreciation of the group as a whole.

FUNGI

Fungi are Thallophyte plants which are characterized by the fact that they do not contain green coloring material, chlorophyll—although other pigments may be present—and whose vegetative body, called the mycelium, is in general a filamentous, cobwebby structure (Fig. 1). Each individual thread or filament making up the mycelium is called a hypha (Fig. 1). Thus we see that the vegetative body or mycelium is composed of a tangled network of hyphae or individual threads (Fig. 1). In some instances the mycelial development may be very limited (yeasts), (Fig. 2), while in other cases the reverse is true, and numbers of hyphae by their association form bodies of definite shapes. This is the nature of the above ground structures that we know as mushrooms, coral clubs, etc. (Figs. 6, 7, 8). For example, take the case of the meadow mushroom, Agaricus campestris. In the soil, there develops a thready whitish mycelium upon which forms the above-ground part, that we so commonly recognize as the meadow mushroom. This above-ground part which connects with the subterranean threads is in reality made up of a great number of definitely arranged hyphae.

Because fungi as a group do not contain chlorophyll, they are unable to make their food as do the green plants. A grass plant may, by virtue of its green coloring material, utilize the energy of sunlight to build up starches and sugars from simpler compounds such as carbon dioxide obtained from the air and water from the soil. But fungi, not having this ability, must obtain their nourishment from

other living or dead plants and animals. Carbon, hydrogen, oxygen, nitrogen, sulphur, phosphorus, potassium, magnesium and iron are all elements needed by living, growing fungi and these are obtained from the plants or animals on which they live—the carbon, hydrogen and oxygen from the sugars, cellulose, starches, etc., of the hosts and the nitrogen from the peptones, asparagin and other nitrogen containing compounds.

If fungi obtain their food from dead bodies, they are said to be saprophytic while if they are dependent upon living organisms, they are termed parasites. Some organisms, also, are capable of living on both living and dead bodies.

The hyphae of a fungus are composed of one or more cells depending upon the group to which the fungus belongs. Each cell (except in a few of the lower forms) consists of a wall of fungus cellulose which is a nitrogenous modification of cellulose and is akin to the animal substance known as chitin. In some of the lower fungi, however, the wall gives the reaction for true cellulose (4). Inside of the cell wall, there is a mass of protoplasm containing one, two, several or many nuclei depending upon just what fungus we are examining. Fats and oils are found as droplets in the cells and represent stored food. Resin may occur as an excretion in certain forms. The following quotation is taken from Harshberger (6). "The intense orange-yellow color of the caps and stipe of the Agaricus (Pholiota) spectabilis, according to Zopf, as also the pale yellow of the gills and the flesh of cap and stipe together with the ochre-yellow color of the masses of spores is due to the presence of a resin acid which is present as a hyphal cell content." Different colors are found in the range of fungi and a chart could be constructed varying from blue at one end (Leptonia) to red at the other (Russula emetica).

Investigations have shown that there is a wide range of ferments present in the group. Just to mention a few as a matter of interest:

Amylase changes starch to dextrin and maltose.
Invertase changes cane sugar to dextrose and levulose.
Maltase changes malt sugar to dextrose.
Trypsin changes proteins to peptides and amino acids.
Lipase changes fatty oils to fatty acids and glycerine.
Oxidase causes a union of oxygen with other bodies.

Active principles such as ergotin, muscarin and coniferin have been found.

Fungi reproduce by cells known as spores. In order to avoid confusion, hereafter, let it be remembered that a spore is a cell generally with a highly resistant cell wall and is of value in the propagation of the species. These spores may either be non-sexual or sexual. The sexual spores are also called the perfect spores, and likewise the non-sexual spores are termed imperfect. There are a number of types of non-sexual spores, each of which bears its own name and has its own peculiarities. More than one type of non-sexual spore may be developed by a species during its lifetime. As examples of a few types of non-sexual spores, the following are common and thus may be cited: The thick-walled spores (chlamydospores) of the smuts, the little pinched-off spores (conidiospores) (Fig. 3) of the green molds, and the spores (sporangiospores) found in the spore cases (Fig. 1) of the bread mold. Sexually-produced spores result when two sexual cells or parts of cells unite. In this way are produced the zygospores of the alga-like lower fungi, and the ascospores of Sac-Fungi (Fig. 4).

In so far as possible, spores will not be referred to by their scientific name in this paper as it would only lead to confusion, and after all, we are concerned with significance rather than name.

We have seen, however, that sexuality is present in fungi. Sexual and non-sexual spores may occur on the same plant or they may be found on entirely different ones. Thus, it is that in the study of certain plant diseases the relationship between the perfect stage (the form in which the perfect spores occur) and the imperfect one has been long unsuspected. Scientists have set aside one class of fungi which they call Fungi Imperfecti which contains the imperfect stages of those fungi (probably mostly Sac-Fungi), for which they do not know the perfect stages; or if they do know them, they do not suspect their connection with the imperfect stages. When the perfect stage of any member of the Fungi Imperfecti is found and related to the imperfect stage, the fungus is at once removed from the Fungi Imperfecti and placed in its proper sub-class together with its perfect stage.

Fungi lend themselves to division into three sub-classes:

I. Alga-like Fungi including the black molds which grow on bread, the mildews, blights and water molds.

II. Sac-Fungi comprising the yeasts, morels, green molds, powdery mildews, etc.

III. Club-Fungi including smuts, rusts, puff balls and mushrooms.

ALGA-LIKE FUNGI

The fungi of this sub-class are characterized by a more or less branched mycelium composed of hyphae which in general are not divided by transverse partitions into cells (Fig. 1). Transverse partitions do appear however to separate the reproductive parts from the vegetative ones. Therefore, it is obvious that the mycelium is made up of unicellular hyphae. These contain many nuclei. Let us take the common black bread mold, Rhizopus nigricans, as an example for closer study (Fig. 1).

(a) Black Bread Mold. If we expose a piece of moistened bread, or a glass containing jelly to the air and allow it to stand for the necessary time, we find that there begins to develop a blackish, thready growth upon the surface of the bread or jelly. This is the mycelium of the fungus and has resulted when spores which are in the air of the room come into contact with the nutrient medium. Conditions being favorable, each spore germinates (Fig. 3, C), that is, sends out tubes (hyphae) which grow and interlace, and in time, there is formed the hairlike mass on the medium. If we examine, let us say, the piece of exposed bread, more carefully, we find that there are three types of hyphae involved. The first type penetrates the bread, and by means of enzyme action changes the carbohydrates of the bread into soluble sugars and absorbs these for nourishment of the mold. Here and there, hyphae rise vertically from the bread, and when mature, end in a little globular head filled with microscopic brownish spores. The third type of hyphae grows along the surface of the bread and when its tip comes into contact with the medium forms a new cluster of subterranean hyphae and also aerial hyphae producing spores (Fig. 1, st). Thus, it is possible for a rapid spread of the fungus on the nutrient medium.

The stalk of each aerial hyphae is separated from the globular head containing the spores by means of a transverse partition. When the spores are ripe, the head breaks open and they are scattered. Some falling to the surface of the bread, germinate and form new plants.

In certain cases the bread mold may show a form of sexual reproduction. Pairs of shorter club-shaped hyphae arise on mycelial

branches near each other. Each club-shaped branch cuts off a cell at its tip, enclosing a mass of dense protoplasm. Each end cell is really a sexual cell. These end cells fuse when brought into contact with each other and the resultant structure (zygospore) formed by the fused end cells enlarges and forms a highly resistant black wall about itself. This fusion of sexual cells alike in structure is known as conjugation. Later, after a period of rest, the zygospore or fusion cell germinates forming an elongated hypha which produces a spherical spore container at its tip. Blakeslee has shown that there are two distinct strains of Rhizopus which he calls the + and the — strains. Conjugation never takes place unless both of these strains are present since the hypha of a — strain cannot conjugate with another hypha of the same strain. Neither can two + strain hypha conjugate. It is necessary to have both a + and a — strain present for the sexual act.

However, there are molds related to the bread mold which can form sexually produced spores by a conjugation of two hyphae from the *same* mycelium.

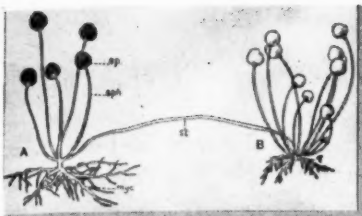
(b) Water Molds. The water molds are of interest since they occur in our streams and ponds and live on the bodies of dead insects, crustacea and organic débris, while a few species attack living fish. Let us use the genus Saprolegnia as a type. Fish have been observed with wounds covered by whitish growth of this fungus. Harshberger (6) states that Saprolegnia ferax usually attacks only fishes, tadpoles and the spawn of frogs. It appears on aquarium-kept fishes on the sides of the body at the tail end or among the gills. When found on the gills, if abundant, it may produce asphyxiation, and the fish turns on its back and rises to the surface. If tap water is allowed to run slowly over dead fishes in a jar in the laboratory, the fungus can usually be secured. Bacteria and certain protozoa retard its development.

Certain members of the Alga-like Fungi produce diseases of economic importance. The following are examples: the white "rust" of mustards which occurs upon the radish, horse radish, turnip and mustard; the downy mildew of the grape, the downy mildew of the cucumber; onion mildew; and the late blight of the potato. As representative, we shall review briefly the features of one of these diseases—the downy mildew of the grape.

(c) Downy Mildew of the Grape. This fungus is a pest in the Middle Atlantic States, reaching westward to the Mississippi River. It was probably introduced into Europe from America where it has given much trouble. It is not a respecter of species and has been found on nearly all species of cultivated and wild grapes, where it attacks the young leaves, shoots and the berries themselves. In a mild attack, it may be confined to the leaves which show irregular yellowish to brownish spots and patches of mildew appear on the lower leaf surface. If the disease is severe, the lower leaf surface may be covered with the cottony mass of hyphae. When the physiological activities are sufficiently interfered with, the whole leaf may dry and fall. If the fruit itself is affected, severe loss may occur. Bordeaux mixture has been used most effectively in combating the disease.

SAC-FUNGI The mycelium of the fungi belonging to this subclass is composed of hyphae which are divided into cells by transverse partitions. Members of this group are characterized by developing little sacs known as asci (Fig. 4) in which are formed a few small spores (ascospores). It has been shown that the ascus is sexual in character for in it two nuclei, usually thought of as sexually different, fuse. The above-ground portions of certain Sac-Fungi form definite and characteristic fruiting bodies in which the sacs or asci are produced. As a group, the Sac-Fungi are the largest, embracing many different forms, some of which are of economic importance.

(a) Yeast (Saccharomyces sp.). Let us examine under the microscope some ordinary compressed yeast which has previously been grown in a satisfactory nutrient solution such as Pasteur's Solution, which is composed of ammonium tartrate, 5 gm.; potassium phosphate, 1 gm.; calcium phosphate, 0.1 gm.; magnesium sulphate, 0.1 gm.; sucrose, 75 gms.; water, 419 gms. The yeast cells are seen to be spheroidal to ellipsoidal in shape, and if we measured them, we would find them to be from 8/25,000 to 12/25,000 of an inch in length and 8/25,000 to 10/25,000 of an inch wide (Fig. 2). It has been estimated that a yeast cell of average size weighs about .000,000,5 milligram. The cell wall is composed of fungus cellulose and incloses a mass of protoplasm or living matter which may be divided into a clear zone lying directly inside of the cell wall and a granular inner portion. A number of minute cavities containing glycogen, a carbo-



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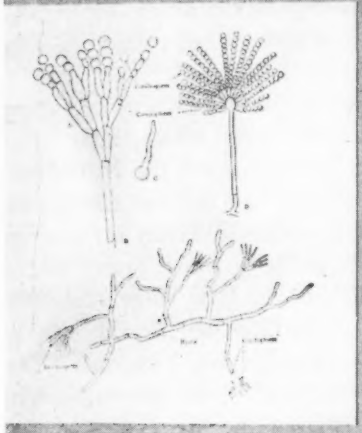

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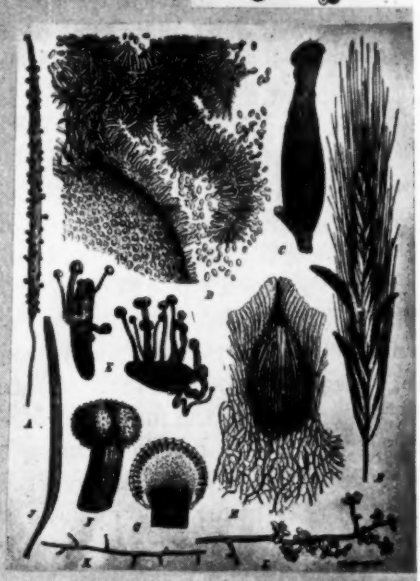

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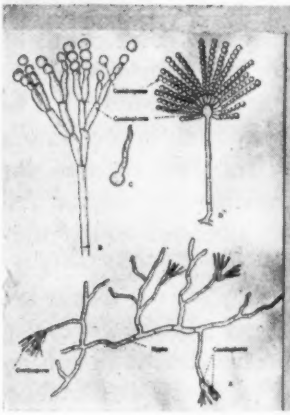

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Fig. 1—Black Mold (Rhizopus nigricans—A, older plant; myc, mycelium; sph, aerial hypha bearing; sp, spore case; st, hypha growing along substratum and giving rise at its tip to a new plant; B, greatly enlarged.

Taken from Youngken, "Pharmaceutical Botany," published by P. Blakiston's Son & Company, Incorporated, who in turn got it from Gager.

Fig. 2—Cells of yeast (Saccharomyces sp.). Some of the cells are budding. The clear spaces are vacuoles.

From Gager, "General Botany," published by P. Blakiston's Son & Company, Incorporated.

Fig. 3—Blue and Green Mold. A and B, common blue mold (Penicillium). C, germinating spore; D, green mold (Aspergillus).

Reprinted by permission from "Textbook of General Botany," by R. M. Holman and W. W. Robbins, published by John Wiley & Sons, Incorporated.

Fig. 4—B—L, Claviceps purpurea; E, sclerotium; C, early stage of Claviceps; D, cross-section of early stage; E, sprouting sclerotium; F, outgrowth formed by sprouting sclerotium; G, section of same; H, section of outgrowth showing asci in cavity; J, ascus; K, germinating ascospore.

Taken from Youngken, "Pharmaceutical Botany," who in turn got it from (Die Naturlichen Pflanzenfamilien I, 1, p. 371). Reprinted by permission of P. Blakiston's Son & Company, Incorporated.

Fig. 6—Polypore. Explanation in text.

hydrate found in many animals especially in the liver and which is a reserve food, is found in the younger yeast cells, but these unite as the cell grows older, and in the mature yeast cell are represented by one large space occupying most of the interior pushing the protoplasm against the wall. A nucleus is also present but cannot be seen unless it be specially stained.

By means of enzymes formed by the yeast cell, the necessary food materials for growth are obtained from the dilute sugar solutions containing sufficient nitrogenous matter in which the yeast lives.

Here and there in the yeast culture that we are examining, we may see signs of a type of non-sexual reproduction known as budding. In this method, the cell wall forms a slight bulge which grows larger and a portion of the protoplasm passes into it. The bulge continues to enlarge and soon there is formed a daughter cell by the closing of the opening at the inner end of the protuberance (Fig. 2). The daughter cell may remain adhering to the wall of the parent, and in turn may form a granddaughter cell (from the standpoint of the original cell) in the same manner. So we may find small chains of yeast in our culture which eventually separate into individuals.

Under certain conditions, little cells called ascospores may be developed. In this case the nucleus of the yeast cell divides into a number of parts (four as a rule) and each fragment becomes the nucleus of a spore—the entire group lying within the original cell wall. At the proper time the ascospores are liberated and if they meet favorable conditions, become new plants.

(b) Blue and Green Molds. These saprophytic forms are found growing on a variety of substances—jelly, leather, decaying fruit, paper, etc. Perhaps the easiest way to recall them is to remember the green crustlike growth that is often found on soft and decaying oranges. Aspergillus and Penicillium (Fig. 3) are two representative genera, and as we have learned before, some species of these have an economic importance. The mycelium or filamentous vegetative body is composed of a feltlike mass of tubular hyphae—each hypha under the microscope showing cells which have a transparent wall enclosing living matter or protoplasm (Fig. 4). Here and there, branches from the mycelium project into the air and pinch off at their extremities numerous small non-sexual spores. The structure of these aerial hyphae may vary, and it is possible for example to tell Aspergillus from Penicillium by their difference in this

character (Fig. 4). The number of spores produced is enormous and the result is a greenish powder which easily separates and is carried about in the air. When the spores fall upon a medium upon which they can grow, germination takes place at once, and new hyphae are produced on the surface of the substratum while certain hyphae penetrate the medium on which the fungus is growing.

(c) Ergot. Claviceps purpurea is a fungus belonging to the Sac-Fungi which parasitizes the fruits of the rye plant, Secale cereale, and other grasses belonging to the Grass family. By means of wind or insects, spores of the fungus are carried to the young ovaries of the rye plant where they germinate, forming hyphae which not only penetrate the base of the grain but also extend over the ovary. By enzyme action they produce a decomposition of the ovarian tissue with the formation of a yellowish substance attractive to insects known as honey dew. In the meantime the fungus has formed numerous small spores so that when the insect visitors are attracted by the honey dew, they come into contact with spores of the fungus as well. Later, when they fly to other rye plants, the disease may be spread by these spores.

As time passes, the hyphae grow, penetrating deeper and deeper into the ovary (which would have become a mature fruit) and gradually eat it, using the food thus obtained as building material for the formation of a dense, slightly curved hard projecting fungal growth from 1 to 4.5 cm. in length. This growth is known as a sclerotium and is the form taken by this fungus, while it remains dormant over winter (Fig. 4).

The sclerotium falls to the ground and undergoes a period of rest, and the next spring, with the return of growing conditions, absorbs water, increases in size and sprouts into a number of bodies having globular heads and long stalks. Each head possesses many small receptacles within which are formed the little sacs or asci (Fig. 4, G. H.), each of which produces eight ascospores. These ascospores when freed from their containers may be carried by wind currents to new rye plants where the cycle of the fungus starts over again in the young fruits.

Many other plant diseases are caused by Sac-Fungi, and time only allows us to mention a few: peach leaf-curl, affecting particularly the leaves and shoots; brown rot of stone fruits—a disease of great economic importance; larch canker; root rot of tobacco; black knot of plums and cherries; black rot of grapes; powdery

mildew of peas; apple scab; bitter rot of apple and chestnut blight. As representative of these diseases and because of its importance to fruit growers both in Europe and United States, the brown rot disease of stone fruits has been chosen for further consideration.

(d) Brown Rot of Stone Fruits. The causative fungus is known as Sclerotinia cinerea, and it affects primarily the stone fruits—peach, plum, prune, cherry and apricot, and at times it may be found on the apple, pear and quince. The flowers and fruits are commonly injured, but the fungus is capable of growing on vegetative parts such as the twig and limbs as well. In the fruit, small brown decayed spots first appear and these may increase rapidly in size (at temperature of 60 degrees to 80 degrees F.) until the whole fruit is affected. At first the fungus grows entirely within the fruit, but after a certain stage of decay is reached, it breaks through the skin—forming grayish spore-bearing tufts which produce abundant spores capable of infecting new fruits with the disease. The fungus winters over in dried-up rotten fruits known as mummies that cling to the trees, and the following spring may infect the flowers. The disease may not only cause financial loss to the farmer in the orchard, but careless handling of the fruit on its way to market may allow spores, clinging to the surface of the fruit, to germinate and thus produce loss while en route (13).

Spore germination proceeds slowly unless there is sufficient moisture and a high enough temperature, 50 degrees F. or above. Growth takes place best when the temperature is fairly high and therefore warm, wet weather encourages the spread of the disease in the orchard.

The mycelium of the fungus is light brown in color, divided into cells and much branched. Recent work by Thomas (16) has led to the conclusion that the outer covering of the hyphae of the Sclerotinia species worked with is composed of an acidic carbohydrate which answered to the tests for the detection of the substance known as callose. While underlying the callose is a basic skeleton of chitin. Certain branches of the mycelium produce a tremendous number of spores which germinate most easily and may even live over winter. While there is no regular formation of sexually produced spores (ascospores), these have been observed from time to time.

Methods of control in the orchard embrace the removal and destruction of the blighted twigs and mummies and judicious spraying

with self-boiled lime-sulphur 8-8-50, adding two pounds of arsenate of lead.

The following statistics to show the importance of the disease are taken from Farmers' Bulletin No. 1435, United States Department of Agriculture publication (13). "In the Eastern and Southern States brown-rot occurs on all stone fruits; in California chiefly on apricots; in the humid sections of Washington and Oregon on all

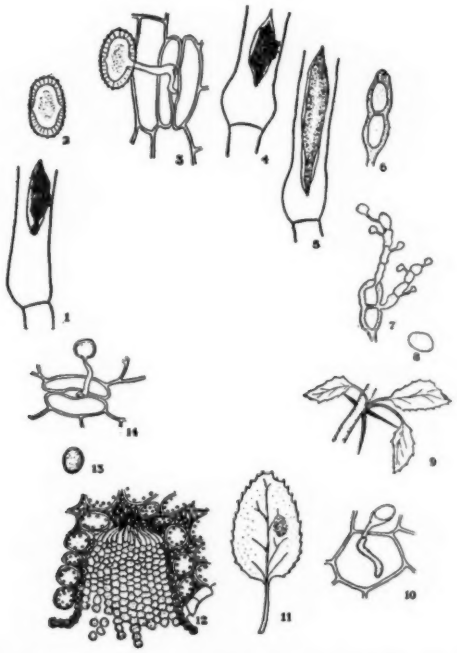

Fig. 5—Life cycle of black stem rust (Puccinia graminis). 1, wheat rust on wheat stem; 2, first type of spore produced by rust fungus seen in first figure; 3, first type of spore germinating on surface of the stem of another wheat plant and soon another crop of spores is borne on the new wheat plant as shown at 4; 5, the second type spore-producing body found later on the wheat plant; 6, a second type of spore produced in 5. These are known as winter spores and remain alive on the straw during the winter; 7, the second type of spore germinating the following spring. Each cell sends out a four-celled filament, each cell of which may produce one of the third type of spores; 8, the third type of spore which if it falls upon a common Barberry leaf, 9, germinates 10, and penetrates the epidermis and forms a mycelium within the tissues of the leaf; 11, a Barberry leaf (lower surface showing cluster cups in which are found the fourth type of spore); 12, a section of a cluster cup on lower surface of Barberry leaf. This is filled with chains of yellowish one-celled spores (fourth type). 13, a single fourth type of spore; 14, fourth type of spore germinating on the surface of wheat. The parasite spreads within the tissue of the host and after a time the first type of spores is produced in character postules as shown in 1.

Taken from Holman and Robbins, "Textbook of General Botany," who mark it (adapted from figure in a Bulletin of the Minnesota Experimental Station). Reprinted by permission from "Textbook of General Botany," by R. M. Holman and W. W. Robbins, published by John Wiley & Sons, Incorporated.

stone fruits, though only rarely on apricots and peaches. Of 1,614 cars of peaches from 24 states examined in 1919 by Federal inspectors, 1,149 showed brown rot to the extent of about 20 per cent, or an average for the total of about 14 per cent. The average in 615 cars from Georgia was nearly 25 per cent, in 67 from Arkansas 10 per cent, and in 41 from New York 10 per cent. The average loss in 597 cars from Georgia in 1920 was 17 per cent and in 677 cars in 1921 11 per cent."

CLUB-FUNGI The Club-Fungi are represented by at least 14,000 species and they are characterized by possessing a mycelium composed of hyphae divided into cells by means of transverse walls, and also by the formation of swollen ends (basidia) of certain hyphae which form spores (basidiospores) on the outside of the swollen portions (Fig. 5, No. 7). It is to be noted here that in the case of the Sac-Fungi, the ascospores are formed on the inside of the ascus, while in the Club-Fungi the basidiospores are formed on the outside of the swollen end cells composing the basidium. Many of the members of this group have characteristically-formed and beautifully colored fruiting bodies, which attract and hold our attention as we chance to come upon them. To the Club-Fungi belong the smuts, the rusts, the "weeping" fungi, the coral or fairy club fungi, the polypores or pore fungi, the mushrooms and toadstools, the puff balls, the nest fungi and the carrion fungi. A few examples of certain common forms representing some of these groups will be discussed.

(a) Corn Smut (Ustilago Maydis). This fungus is parasitic on the Indian Corn, attacking the young growing parts of various organs such as the ears of grain, husks, leaves, stems and roots. The mycelium proliferates through the infected part, and in time produces large swellings which are covered by a silvery membrane and at maturity contain a mass of dark brown, thick-walled, spiny, nearly spherical spores. Upon liberation, these spores fall upon the earth. After wintering in the soil, the return of spring with its favorable conditions causes them to germinate—each germinating spore forming a short, cellular filament which in turn produces another type of spore (basidiospore). The basidiospores are carried to other young corn plants which, if opportunity presents itself, they infect, and thus complete the life history of the fungus. It is not an uncommon occurrence for smutted ears of corn to be present in our markets.

Enormous numbers of spores are produced, and it is a difficult thing to get rid of the pest after the soil in a field has become infected. It has been estimated that about 25,000,000 spores would be needed to cover a square inch of surface. From 1917-1920, corn smut is said to have caused a loss of about eighty million bushels per year. The disease is fought by cutting out the infected areas before the smut matures and destroying them by burning.

(b) Wheat Rust (Puccinia graminis). Puccinia graminis is of great importance since it harms some of our most important agricultural crops, wheat, barley, oats, etc. The annual loss for the whole world sometimes is estimated to reach $100,000,000. According to Gager (5) the loss from stem-rust of wheat in United States during the years 1919-1923 amounted to an average of over thirty million bushels with an average annual loss of over $38,400,000.

The life cycle of the wheat rust illustrates how an apparently harmless plant, innocent of producing disease, may act as a harborer of a fungous pest and in this way may become a menace. And that is the rôle played by the common barberry plant which may often be found in the vicinity of wheat fields. Let us see how this comes about (Fig. 5).

During the summer, rust-red lines appear on the stems and leaves of the wheat plants parasitized by this fungus. The mycelium of the fungus grows between the cells of the stem and leaves of the infected wheat plants and finally spore-producing hyphae, which when mature bear one-celled reddish spores, break through the epidermis forming the reddish lines previously mentioned. In the meantime, the fungus has been deriving its food by robbing the wheat so that the grains developed are small and soft. These reddish spores are blown about by the wind and many infect other healthy wheat plants they chance to alight upon. As millions of these tiny bodies are produced, the spread of the disease may be very rapid. Observation has shown that the spores are also capable of retaining their vitality and wintering-over, thus infecting healthy plants the following spring.

Later in the year, the same mycelium which developed the reddish summer spores forms other two-celled blackish thick-walled resting spores. This second type of spore, after spending the winter on the stubble of the wheat in the wheat field, germinates the next spring—each cell forming a short filament of four cells. The cells of these filaments produce spores of a third type (basidiospores) which are

blown about by the spring breezes until they come by chance to rest upon the leaves of a barberry plant (Fig. 5).

The third type of spore (basidiospore) forms a mycelium which penetrates the epidermis of the barberry and grows between the cells of the inside of the leaves. There are certain species of barberry such as the Japanese barberry which apparently are not attacked by the fungus. Other spores, the fourth type, are produced in great numbers on the barberry, and these in turn are carried to new wheat plants. It has been calculated by Buller that a single barberry leaf may have produced upon it from four to eight million spores and a single bush with 200 leaves, about 100 million spores. Thus, we see that the disease may spread quickly and may be hard to control. In fact, in an investigation of the spores found in the upper air by Stakman, Henry, Curran and Christopher (15), spores of Puccinia graminis were caught at elevations of 7000 feet. In the same study two spores that were apparently of Puccinia triticina were obtained as high as 16,500 feet.

The life history of the wheat rust is particularly cited here because it is an example of plant parasite living alternately on two different hosts—wheat and barberry.

(c) Coral Clubs. These are fleshy fungi, saprophytic on leaf mold and characterized by their upright growth, often beautifully branched, and colored in shades of pink, violet, yellow or white, resembling certain coral growths. It is said that many of the members of this order are edible and that none are known to produce harmful effects.

(d) Pore Fungi. Doubtless in your trips through our woodlands you have seen fallen trees almost covered with flattened, often corky or leathery outgrowths, at times almost earlike in shape. Or perhaps you have noticed the hardened bracketlike growths often reaching a considerable size, projecting from the trunks of upright trees. These are examples of polypores. Each outgrowth, as the name indicates, upon closer examination, is seen to be penetrated by numerous small holes. Each hole is the open end of a tube which is lined with a spore-producing layer, and the spores escape through the open ends of the tubes. As the tubes are packed side by side, the appearance is that of a surface penetrated by innumerable tiny pores.

The mycelium to which the obvious fruiting portion is connected, penetrates the wood of trees and causes it to decay by using

as food certain parts of the cell walls so that these walls are broken down and the tree in time may be killed. Merulius lacrymans, the dry rot fungus which attacks structural wood work and timbers causing them to decay and crumble belongs to this group. The pore fungi in general represent great diversification in their structure, general appearance and consistency. The writer recently had an interesting experience with a pore fungus. When collecting one day, he put two or three of these fungi into a collecting can together with some parts of shrubs, flowers and leaves. On the following day, when the can was opened, it was found that one of the pore fungi, although it previously had no connection with it, had grown part way around one of the leaves (Fig. 6).

(e) Mushrooms and Toadstools. This group of fungi is perhaps most commonly known, and is the one that is usually meant when the layman refers to fungi. To it belongs the common meadow mushroom, Agaricus campestris, and the poisonous "fly agaric" Amanita muscaria, and the "deadly agaric," Amanita phalloides. The members of the group are characterized by a fleshy fruiting body consisting of a stalk or stipe surmounted by a cap possessing radiating gills on the under surface (Figs. 7, 8). Various forms differ in size, the character of the stalk and cap and color of the spores produced. For example, mushrooms may be divided into five subdivisions depending upon the spore color when placed on an opaque surface—white, ochre, rosy, brown and black. Let us study our common meadow mushroom more closely, using it to represent the group.

(1) Common meadow mushroom (Agaricus campestris). When a spore of Agaricus germinates, it forms in time a thready mycelium

Fig. 7—Meadow mushroom (Agaricus campestris). A, view showing underside of cap; g, gills; a, annulus, or remains of the veil attached to the stipe; B, side view; s, stipe; a, annulus; p, margin of cap, showing at intervals the remains of the veil.
Taken from Gager, "General Botany," published by P. Blakiston's Son & Company, Incorporated, where it is marked (after W. A. Murrill).

which leads a saprophytic life in the substratum. There must be sufficient organic material such as manure, dead and decaying vegetation, etc., present. Moisture, warmth and decaying vegetation are necessary for growth. After a while, however, little white buttons develop upon the mycelium. At first they are very small—about the size of a pinhead—but they grow larger and become pear shaped.

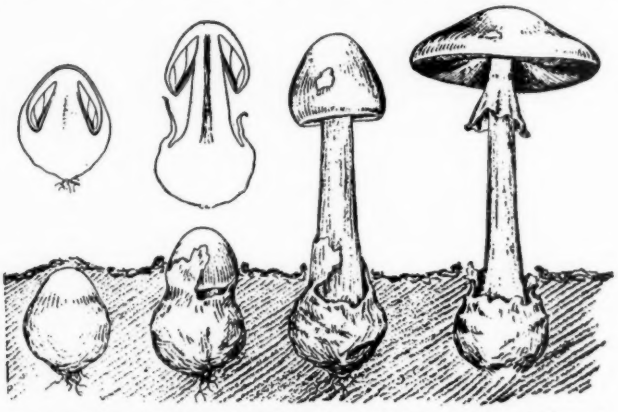

FIG. 306.—Stages in the development of a gill fungus (*Amanita*). See explanation in text. (After Longyear.)

Fig. 8—Amanita—Stages in the development of a gill fungus (Amanita). Explanation in the text.
Reprinted from "Textbook of General Botany," by R. M. Holman and W. W. Robbins, published by John Wiley & Sons, Incorporated.

Each little pear-shaped body consists of a solid cylindrical stalk with a cap at the top. The gills on the under surface of the cap cannot be seen because of a membrane composed of a thin sheet of mycelial threads which extends from the edge of the cap to somewhere on the surface of the stalk or stipe.

However, the fruiting body is growing and as the stalk elongates and the cap expands, the sheet of hyphae or partial veil as it is sometimes called is broken leaving part attached to the edge of the cap and part somewhere on the stipe. The latter part forms the annulus or collar found about the stem of Agaricus. The mushroom has by now taken on the shape of a parasol. On the under side of the cap may be seen a series of thin pinkish plates (later turning brownish) radiating from the stalk to the margin of the cap. These are the gills (Fig. 7). Study shows that the surface of the gills is covered by a fruiting or spore-producing layer. The number of brown spores formed by a single meadow mushroom must be enormous, for in one

research the record shows that 1,800,000,000 spores were liberated in a plant of Agaricus campestris 8 cm. in diameter. When we think of the countless thousands of Agaricus mushrooms produced each year, the total number of spores staggers imagination, and we realize that the death rate must be unbelievably great.

The edible common mushroom is found growing in groups in open fields and lawns during the late summer and early fall. Because of its gastronomic value, it is extensively cultivated by men who have made a study of mushroom growing. Pieces of "bricks" composed of horse manure through which the mushroom mycelium is growing is used to "seed" special beds made of horse manure and loam. Other conditions being favorable, with sufficient watering, mushrooms will soon appear. Anyone interested should turn to works devoted to mushroom growing.

(2) Amanita. The handsome poisonous fly agaric, Amanita muscaria dwells in coniferous woods or along roadsides and borders of fields, and the deadly destroying angel or death cup is found in groves, woods and pastures. The cap of the fly agaric is orange-red to pale yellow or almost white with warty scales and that of the death cup is white or greenish or greyish brown. The fly agaric is said to have caused the death of Czar Alexis of Russia.

The deadly destroying angel is extremely poisonous and there is no known antidote except emetics and blood transfusion which may not give much relief. Youngken (17) states that the chief poisonous constituents of Amanita phalloides are the glucoside, (Glucosides are substances which are split into a sugar [glucose] and other compounds when acted upon by a ferment, dilute acids or alkalies), amanitahemolysin and a poison called amanita-toxin. These are long names and perhaps do not mean anything to us, but the following description taken from Harshberger (6) after Chestnut certainly has an unmistakable significance. "The fundamental injury is not due, as in the case of muscarin, to a paralysis of the nerves controlling the action of the heart, but to a direct effect on the blood corpuscles. These are quickly dissolved. . . . No bad taste warns the victim, nor do the preliminary symptoms begin until nine to fourteen hours after the poisonous mushrooms are eaten. There is then considerable abdominal pain and there may be cramps in the legs and other nervous phenomena, such as convulsions and even lockjaw, or other kinds of tetanic spasms. The pulse is weak, the abdominal pain is followed rapidly by nausea, vomiting, and extreme diarrhoea. . . .

The latter symptoms are maintained persistently, generally without loss of consciousness, until death ensues, which happens in from two to four days." Fortunately, atropine has been found to be an antidote for muscarin poisoning caused by eating Amanita muscaria—the fly agaric. An emetic should first be given (17).

The fruiting bodies of the Amanita also begin as little buttons on the mycelium (Fig. 8). As the button grows, it becomes dumbbell shaped and the entire fruiting body—cap, stalk and gills—is enclosed by a universal veil (Fig. 8). As the stipe elongates, the universal veil breaks leaving its upper part on the cap and its lower forming a cup at the base of the stem—the so-called death cup (Fig. 8). A false annulus develops on the stipe. The gills and spores are white. It may be restated here the novice should not collect and eat fungi without consulting an expert. Be sure and be safe.

With respect to fungi used as food, Marshall (9) gives the following under "Cautions for the Inexperienced."

"Never use specimens which are decomposed in the slightest degree.

"Never use those which are at all burrowed by insects.

"Never collect, for food, mushrooms in the button stage, as it is difficult for a novice to distinguish the buttons of poisonous species from the buttons of harmless species.

"Never use fungi with swollen bases surrounded by sac-like or scaly envelopes.

"Never use fungi with milky juice unless the juice is reddish.

"Never use fungi with caps thin in proportion to the width of the gills when the gills are nearly all of equal length, especially if the caps are bright coloured.

"Never use for food tube-bearing fungi in which the flesh changes colour when cut or broken, nor those with the tubes reddish. Be very cautious with all fleshy tube-bearing fungi.

"Never use for food fungi with a web-like ring around the upper part of the stem."

To the above should be added the caution of never eating forms that are broken and incomplete—because the missing portion may show the specimen to be poisonous.

(f) Puffballs: The whitish mycelium of this group is found growing in and absorbing nourishment from decaying plant matter. Little rounded growths appear on the white feeding hyphae but they do not form gills and stems as happens in the case of the Agaricus

campestris. At first the growths or balls contain a white mass of flesh within, but at maturity they consist of a rather thick covering surrounding a mass of spores which escape in various ways. If we squeeze a mature puffball we may see the little dustlike cloud of spores which escape to go about their mission of propagating the plant. The mind cannot grasp the countless millions of spores formed inside of the body of a puffball. An averaged sized Giant Puffball (16 by 11 by 8 inches) was estimated to produce about 7,000,000,000,000.

In the earth star, Geaster, the outer rind splits into a number of lobes which spread out producing a starlike appearance of the plant.

(g) Carrion Fungi. These are Club-Fungi which at maturity produce their spores in an overpoweringly-fetid greenish slime which attracts carrion flies. The spores are thus disseminated by the flies, and the plants are spread to new localities.

FUNGI IMPERFECTI

As we have previously learned, the Fungi Imperfecti is a group of miscellaneous forms whose perfect stages are not known or not correlated. As their complete life cycle becomes known, the members of the group will, whenever possible, be automatically transferred to their natural genus. Many of the Fungi Imperfecti cause plant diseases, and at this time the following may be mentioned: potato scab, rice blast, flax wilt, early blight of potato, leaf spot of beets, leaf blight of cotton, fruit spot of apple, leaf spot of pear, black rot of sweet potato, anthracnose of cotton, anthracnose of bean, etc., etc., through a formidable list of diseases. The group will be represented by a few words on leaf blight of the tomato.

(a) Leaf Blight of the Tomato (Septoria lycopersici). This is one of the most serious widely-spread fungous diseases affecting the tomato leaves. The leaves develop small angular spots, curl and eventually dry and fall. Vine and fruit may also be infected. Spores are formed on the leaves in the spots and the fungus probably winters over in the leaves (3). Treatment by Bordeaux mixture of proper strength when the plants are young may bring about prevention of the disease. The first application is made two weeks after the plants are set out, and repeated every two weeks throughout the season.

Conclusion

If the reader of this paper has gained some idea of the fascinating complexity of the fungi as a group, if he has been awakened to their immense economic importance, and if he has been stimulated to study them further (no matter the line of his approach—identification, life history, plant diseases or economic use), then the purpose of the author has been accomplished. Undoubtedly the future will add much to our knowledge concerning them, resulting in more successful control of those inimical to our welfare and in the discovery and utilization of new forms that are our friends.

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MEDICAL AND PHARMACEUTICAL NOTES

CALCIFEROL, A POTENT FORM OF VITAMIN D—A crystalline form of vitamin D, more potent in its ability to prevent and cure rickets than any similar preparation now known, has just been prepared by a group of scientists working at the National Institute for Medical Research in London.

The men who have made this remarkable scientific contribution are Drs. F. A. Askew, H. M. Bruce, R. K. Callow, J. St. L. Philpot and T. A. Webster. The leader of the group, Dr. R. B. Bourdillon, was prevented by illness from taking active part in the last stage of the work. This new form of vitamin D is called "calciferol" by its discoverers. They say of it: "The antirachitic activity of calciferol is the highest yet recorded in known units for any preparation." Calciferol has more of this antirachitic potency than the crystalline preparation of vitamin D recently reported by the German Nobel Prize winner, Prof. Adolf Windaus of Goettingen, Germany, the British investigators state in their report to *Nature,* scientific journal published in London. Prof. Windaus has two vitamin D substances which he calls vitamin D_1 and vitamin D_2. Calciferol is not the same as D_1 but is much like vitamin D_2 in such physical properties as have been described. Prof. Windaus' vitamin D_2, however, has approximately the same activity against rickets as D_1. In this it differs from calciferol, which has much greater antirachitic activity than D_1, the British scientists found. Consequently they concluded that the two substances, calciferol and D_2, are not identical. Calciferol has been proved by them to be a direct product of the irradiation of ergosterol, known for some time as the parent substance of vitamin D. It has the same elements in the same relative proportion as ergosterol, although the structure of its molecule may be different from that of ergosterol.—*Science Service.*

NEW SUPER-MICROSCOPE FOR BACTERIOLOGY—Working behind jealously guarded closed doors, two scientists at Pasadena, California, are using what is said to be the world's most powerful microscope, for the examination of almost invisibly fine structural details of the minute organisms that cause disease. The instrument, which Dr.

Royal Raymond Rife of San Diego has spent the past fourteen years developing in the seclusion of his own workshop-laboratory, can magnify small objects seventeen thousand diameters, making an ordinary bacillus look as big as a man's thumb and showing things about it that no microscope hitherto in use has ever made visible at all.

The present use to which the new super-microscope is being put is a search for life secrets of the "disappearing-act" bacteria, which Dr. Arthur L. Kendall of Northwestern University Medical School recently showed can be changed from solid though tiny creatures, visible with ordinary microscopic magnifications, into invisible but still living viruses that can pass through the pores of fine porous porcelain filters and, on being given suitable kinds of food, again become solid germs. The details of the "dissolution" of these bacteria into their filterable form can be shown only somewhat fuzzily with the usual type of microscope, and it may be that the present research will show them up more clearly and thereby aid man in his long battle for mastery over microbes.

The work, which is being done at the Pasadena Hospital, is still shrouded in close secrecy; but it was announced that a few scientists will be permitted to see the instrument within a week. In all the years during which Dr. Rife has been developing his instrument, only a handful of persons, most of them scientists, have ever been admitted to his laboratory—*Science Service.*

New Super X-Ray Tube Equal of World's Total Radium —All the radium in the world could not make more intense rays for the treatment of cancer than the new 900,000 volt, cascade X-ray tube of the New York Memorial Hospital, Dr. G. Failla told his fellow physicists at the recent meeting of the American Physical Society.

One and one-half inches of lead are easily pierced by the rays from the new tube, which was developed by Dr. W. D. Coolidge of the General Electric Company.

Danger to workers with this tube, run for several hours a day, is considerable, said Dr. Failla, in describing the protective means employed in the laboratory.

Running at 700,000 volts and five milliamperes, the radiation from the tube is said to be equivalent to the rays from 600 grams of radium, the total amount isolated pure in the world. More than

anywhere else in the world, some eight grams of this is located at the Memorial Hospital itself.

New methods of treating cancer victims were sought in these experiments, comparing the new X-rays with radium rays.—*Science Service.*

DETERMINATION OF CARBON MONOXIDE PRODUCED FROM PAINTED SURFACES IN CONFINED SPACES—F. H. Newington, *Chemistry & Industry,* October 2, 1931, p. 371. A workman entering a closed compartment of one of His Majesty's ships, died from what proved to be carbon monoxide poisoning. This case was investigated and it was discovered that this particular compartment was closed for a period of five years, was constructed of steel, and was internally painted with oxide of iron paint composed of oxide of iron pigment, boiled linseed oil, and paste driers only. The compartment had been originally closed while the paint was still wet. Various tests in this compartment were conducted, naturally after it was ventilated, and these examinations proved conclusively that the carbon monoxide present in the air of the ship's compartments had originated from the linseed oil in the oxide of iron paint, and also that it is produced both from boiled and from raw linseed oil during the process of drying. Provided excess of linseed oil is present, as must always be the case in a compartment internally coated with paint, the maximum concentration of carbon monoxide to be expected in the closed atmosphere would appear to be of the order of 0.4 per cent. Described are methods of tests conducted and equipment used.

LABELING "ANTIFREEZE" MIXTURES—Automobile "antifreeze" mixtures of more than 15 per cent. methanol henceforth are to be identified by added quantities of purple coloring matter, tartar emetic, and chloracetophenone, or tear gas, under the provisions of an agreement, effective July 1, 1931, reached by the United States Public Health Service with industries concerned. All solutions of more than 15 per cent. free methanol, whether used in industry or in "antifreeze" mixtures, are to be labeled plainly "Poison."

NEWS ITEMS AND PERSONAL NOTES

CAREER LEAFLETS—United States Department of the Interior, Office of Education, Washington. A series of guidance leaflets on Careers by Dr. Walter J. Greenleaf, specialist in higher education, is being published by the Office of Education. Several of these leaflets first appeared as mimeographed circulars, but this supply is now entirely exhausted.

This series on college counseling and advising for the professions is designed for use of high school and college students, orientation classes, guidance committees, counselors, teachers and parents. The leaflets explain what the occupations are, what preliminary education is required, where professional training is offered, length of training, student budgets, etc. They also included selected references.

Leaflets 5 to 39 inclusive will be devoted to careers. The series now includes the following:

Leaflet No. 5—Law.
Leaflet No. 6—Medicine.
Leaflet No. 7—Dentistry.
Leaflet No. 8—Journalism.
Leaflet No. 9—Librarianship.
Leaflet No. 10—Architecture.
Leaflet No. 11—Civil Engineering.
Leaflet No. 12—Electrical Engineering.
Leaflet No. 13—Mechanical Engineering.
Leaflet No. 14—Pharmacy.
Leaflet No. 15—Nursing.
Leaflet No. 16—Forestry.
Leaflet No. 17—Music.
Leaflet No. 18—Veterinary Medicine.

The general price of these leaflets is five cents per copy. Quantity rates will be quoted on request. Purchases should be made through the Superintendent of Documents, Government Printing Office, Washington, D. C.

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MURAL PAINTINGS DEDICATED AT PHILADELPHIA COLLEGE OF PHARMACY AND SCIENCE—Two murals continuing the series of paintings depicting the progress of pharmacy through the ages were unveiled and dedicated at a ceremony at the Philadelphia College of Pharmacy and Science, November 25. One of the murals was presented by E. R. Squibb and Sons in memory of Dr. Edward R. Squibb. One of Dr. Squibb's first assistants in his pioneer research work was Joseph P. Remington, for forty-four years professor of pharmacy at the Philadelphia College, and its dean for twenty-five of those years. The presentation was made by Theodore Weicker, vice-president of E. R. Squibb and Sons. Another mural in the series was unveiled and dedicated at the same time as a gift of the 1931 graduating class. Presentation was made by Theodore Campbell, Jr., a member of that class. With the unveiling of these two murals the Philadelphia College foyer now contains four of the projected series of six mural paintings showing the development of the art and science of pharmacy from earliest recorded history to its present day eminence. The first two of the mural paintings in the series were presented by Dean and Mrs. Charles H. LaWall, both graduates of the Philadelphia College, at ceremonies there June 8. In his speech of presentation, Vice-president Theodore Weicker of E. R. Squibb and Sons spoke as follows:

"We are gathered here to witness a significant event. The human race, since the beginning of its upward struggle, has used pictorial art to beautify its abodes and to tell its most important stories. This picture making was not a mere playful pastime. It was in all recorded periods of history an earnest effort of the human mind to tell, in more or less permanent form, the life, the hopes, the aspirations of man. At first these efforts were necessarily crude, the materials used were those near at hand, clay, wood, stone, vegetable fibre—the artwork was rough line drawing. From such poor beginnings there evolved gradually, very slowly, a better use of more suitable materials and a more articulate and more perfect expression of the message to be conveyed. These two murals to be dedicated this afternoon are just such human documents, painted to beautify this abode of higher learning, to please the eye of all who enter here, by their artistic value, and to cause the mind of the beholder to dwell upon the message they convey,—*the message of the blessings brought to mankind by pharmacy, in providing products that comfort and heal.* We of the House of Squibb wish to express to you our thanks for the

privilege you accorded us, of co-operating with you in the placing of one of these historic documents. We rejoice with you in the successful execution of your high purpose not only because of the warm regard in which we hold your great institution, but also because you and your associates have deemed it wise and fitting to commemorate on this occasion our revered founder, Dr. Edward R. Squibb and his life long friend and co-worker, Dr. Joseph P. Remington, by making the portraits of these two eminent exponents of pharmacy an integral part of the pictorial message. I have the honor to dedicate the mural, thus distinguished, to the cause of pharmacy, so nobly served by the Philadelphia College of Pharmacy and Science."

UNDER-GRADUATE SCHOLARSHIPS AWARDED AT PHILADELPHIA COLLEGE OF PHARMACY AND SCIENCE—The winners of the twelve scholarships awarded annually to under-graduates at the Philadelphia College of Pharmacy and Science has just been announced.

The oldest scholarship at the College is the Peter Williamson Scholarship won this year by Hershel Silas of Philadelphia of the third year pharmacy class. This scholarship was founded in 1874 by Mr. Williamson, who was one of the founders of the Philadelphia College and secretary of the organization meetings held in Carpenters' Hall, Philadelphia, in 1821.

The John M. Maisch Scholarship goes this year to Abraham Krigstein of Wilmington, Delaware, also a member of the third year pharmacy class. This scholarship was founded by John M. Maisch who was for many years professor of materia medica and editor of the AMERICAN JOURNAL OF PHARMACY, the oldest pharmaceutical journal in the United States. Professor Maisch was internationally renowned in his field.

Another scholarship carrying the name of a famous member of the staff of the Philadelphia College is the Robert Bridges Scholarship, awarded this year to Robert M. Reynolds of Philadelphia, a second year student in pharmacy. Robert Bridges was professor of chemistry at the Philadelphia College for forty years, from 1842 to 1882.

The Thomas S. Wiegand Scholarship was awarded this year to Louis Slutsky of Philadelphia of the third year pharmacy class. This scholarship carries the name of a man who was registrar and librarian of the Philadelphia College for thirty-one years.

Jack N. Sandman of Philadelphia, a member of the third year pharmacy class has won the Thomas H. Powers Scholarship. This

scholarship was established at the Philadelphia College by Mr. Powers, one of the founders of the Powers-Weightman-Rosengarten Company, now merged with Merck and Company.

The Edward C. Jones Scholarship went to Robert H. Lentz of Treichlers, Pennsylvania, a second year pharmacy student. Edward C. Jones was a trustee of the College from 1874 to 1895 and treasurer of the Philadelphia College Alumni Association from 1868 until his death in 1895. The scholarship was established by the alumni association to honor his name.

The Troth Scholarship has been awarded this year to Marlin B. Stetler of Middleburg, Pennsylvania, a second year pharmacy student. It was established by the descendants of Henry and Samuel F. Troth. Henry Troth was one of the active workers in the founding of the Philadelphia College in 1821; in fact, by some he has been credited with originating the entire idea. His younger brother, Samuel F. Troth, served as treasurer of the Philadelphia College and vice-president from 1838 to 1867. He was a member of the first class graduated in 1823.

The James T. Shinn Scholarship was established in his memory by his daughter. Mr. Shinn was a graduate of the Philadelphia College in the class of 1854. Miss Margaret M. Petruno of Glen Lyon, Pennsylvania, a second year pharmacy student, has been awarded this scholarship this year.

The Pennsylvania Alumni Scholarship, awarded annually to a science student, went this year to Saul Malasky of Lakewood, New Jersey.

The Class of 1884 Scholarship, established by the graduates of that class, was awarded to Sigmund Moerman of Atlantic City, New Jersey.

The Dobbins Scholarship, awarded annually to the freshman student from New Jersey who obtains the highest average in a special competitive examination, was won by Edwin B. Dunham of Princeton, New Jersey. This scholarship is named for Edward T. Dobbins and was established by him in his will. Mr. Dobbins graduated from the College in 1862 and later became one of the trustees.

Norman E. Foster, of Collingswood, New Jersey, a freshman student at the Philadelphia College, is the winner of the scholarship established by the Breyer Ice Cream Company. This scholarship provides $300 a year during his entire college course. The award is made upon the basis of a competitive examination reviewed by representatives of the Philadelphia College, the Breyer Ice Cream Company and the Philadelphia Association of Retail Druggists.

BOOK REVIEWS

FIGHTING DISEASE WITH DRUGS. THE STORY OF PHARMACY. A symposium edited by John C. Krantz, Jr., with an introduction by Dr. James H. Beal, and contributions by various writers. A publication of the National Conference of Pharmaceutical Research. The Williams & Wilkins Company, Baltimore, Md.

This book is truly the story of the drugs on the shelves of the drug store—the drugs which are passed over the counter, put into mixtures and dispensed in prescriptions. It is a story—not a catalog, guide book or pharmacopœia. In scanning the pages we are reading a narrative, a tale, that at times becomes an epic.

In the pages we read the story of the conquest of disease by drugs. The questions "What are drugs?" "Where do they come from?" "How are they obtained or produced?" "How do they act to prevent, alleviate or cure disease?" are answered briefly and concisely. Each chapter is by an author especially qualified to speak upon the particular subject which he presents.

Briefly, the chapters run as follows:

Introduction, by Dr. James H. Beal, wherein we learn of pharmacy as the nursery of other sciences, the standards for drugs and medicines and the influence of pharmaceutical organizations.

The Quest for Health, by Oliver Kamm, gives a history of man's fight with disease, how drugs are developed, the accomplishments of medical science, including the modern crusade.

The Dawn of Pharmacy, by A. R. L. Dohme, leads us into the rise of pharmacy from obscure beginnings and the part which pharmacy has taken in broadening the knowledge of drugs for use in the war against disease.

The Source of Drugs, by E. F. Kelly, classifies drugs according to their source, natural products, products of chemical and biological synthesis, and tells of the role which pharmacy has played in the development of these products.

Drugs From the Vegetable Kingdom are discussed by Heber W. Youngken. In doing this, he briefly records the history, romance and scientific possibilities of some of the well-known vegetable drugs and appends a table of those which are in common use.

William J. Husa digs into the earth and tells us of the drugs obtained from the rocks, the mineral drugs and the gases from the air.

The story of Bacteria Made Drugs and Vitamins is told by Dr. John F. Anderson. In this we learn of the triumphs gained through the use of serums and antitoxins; the conquering of certain diseases by vitamins.

In a chapter, Drugs Made By Man: The Duplication of Natural Products, by Roger Adams and Oliver Kamm, we see how the chemist-pharmacist has duplicated many of the substances which nature furnishes. Striking examples of these are the experiments with the alkaloids and the hormones.

Drugs Made By Man: Building New Compounds, by Ernest H. Volwiler, is an extension of the previous chapter. In it the synthetic products are discussed, including the anæsthetics, the antiseptics, and the soporifics.

The standardization of drugs is discussed in the chapter How Drugs Are Made Uniform, by James C. Munch.

In Drugs, The Law, and The Public Health, by Robert L. Swain, we see a picture of the law standing as a traffic officer in the field of public health, commanding this and forbidding that. In this chapter, we see that "the law seeks to make actual and real the ideal to which man continually aspires."

W. Bruce Phillip charmingly places The Corner Drug Store in its rightful place in the life of the community.

In the final chapter The Outlook of Pharmacy in The Era of Science by John C. Krantz, we are carried into the future and given a glimpse of the coming zeal with which science, medicine and pharmacy will continue the conflict against disease.

There are weak spots here and there in the book. Some of the writers at times grow verbose. It takes them some time to launch into their theme. At times they stray away from their subject and overstress certain phases.

But, in editorial parlance, "it is all good stuff." The book is well illustrated and is a creditable specimen of the bookmaking art.

The man who serves behind the drug store counter, upon reading this book, will find himself enlightened and elevated. He will realize that drugs still hold a strong place in the combat with disease and in the conservation of health.

In one way or another, the druggist should induce his medical patrons to read the book. It would tend to change their views as to the place of pharmacy in the healing art.

While not in any sense a "thriller," it is a book which intelligent laymen can appreciate.

Druggists who sell books may well push the sale of this volume. It could find a place in the drug store lending library.

The issuance of the volume "Fighting Disease With Drugs" is a notable event in pharmacy.

Fred. B. Kilmer.

THE NEW BELGIAN PHARMACOPŒIA—The Pharmacopoée Belge, of which the fourth edition was issued toward the close of 1930, is a fine example of the art of bookmaking and a survey of its contents shows that it reflects many illuminating facts concerning the practice of pharmacy and of medicine, respectively, in the country which it represents. The volume is bound in soft maroon colored leather, flexible and stamped in gold.

It contains 754 pages (our own U. S. P. contains but 626 pages), and is divided into two parts, the first of which contains the monographs on the official substances, and the second, the reagents and test solutions and tables of various kinds.

Twenty-five years have elapsed since the third edition appeared, and no supplement has been issued since 1912, so we are prepared to find many changes in comparison with the previous edition.

The first and most important change is in the adoption of French as the language of this edition, instead of the Latin in which the third edition was printed. There is also an edition in Flemish.

The Commission responsible for the revision of the work consists of nine members, of whom six are pharmacists and three are physicians. It is an illuminating fact that since this Commission was appointed by Royal decree in 1909, there have been eight deaths (the vacancies being filled by Royal appointment), and the Commission has had four different presidents and three different secretaries.

It is surprising to note the small number of deletions, numbering only fifty. There are, however, one hundred and thirteen additions, many of them being the newer synthetics which have appeared since the third edition appeared.

A survey of the list of monographs shows a curious melange of the old and the new. Quoting official titles verbatim we find (among many others) the following:

Absinthium, Absinthii Extractum, Absinthii Tinctura, Acetylparamidophenolum Salicylicum, Acidum 4-oxy-3-acetylaminophenylarsinicum, Acidum 2-phenylquinolum-4-carbonicum, Angelica, Argentum Vitellinatum, Benzophenolum, Benzoylaethyldimethylaminoisopropanoli hydrochloridum, Bistorte Rhizoma, Boldo Folium, Diaethylaminum 4-oxy-3-acetylaminophenylarsinicum, and so on throughout the alphabet. Which goes to prove several things, one of which is that the new Belgian Pharmacopœia is a sort of combination of the U. S. P. and the N. F., illustrating both the very old and the very new, and also that the prescription-writing physicians of Belgium must be good linguists, unless, as we suspect, they fall back upon Salophen, Stovarsol, Cincophen, Argyrol, Phenol, Stovaine, and Acetylarsan—to supply some of the simpler names of the Latin titles above quoted.

We arrive at an insight into the practice of pharmacy in Belgium by scanning Part II. Here, of course, we find the same kind of reagents, indicators and test solutions as are found in our good old U. S. P. But there are others. There is a list of six pages of reagents which the pharmacist *must* have on hand in the specified amounts; a list of necessary pharmaceutical apparatus, four pages, which *must* be kept on hand in order to properly handle the necessary professional and technical operations; and what is more, it is *required* that every pharmacist have available a laboratory table fully equipped for carrying out the pharmaceutical operations and analytical work prescribed by the Pharmacopœia.

There is a list also, covering fifteen pages, which enumerates the list of official substances (and the amount in each case) which the pharmacist *must always* have on hand for supplying the pharmaceutical needs of his community. We are interested to learn also, upon scanning the work, that the abbreviation "N. D." is attached to the titles of trade-marked articles, and that the abbreviation "N. I." means *Nomen Internationale,* and the abbreviation "P. I." means *Prescriptio Internationale* (we call it Protocol Internationale in our own U. S. P.; which is correct?)

In the text of the book the official titles of certain monographs are accompanied by symbols. The symbol + indicates that the substance may not be dispensed without a poison label, the size, shape, and details of such label being specified in the preface, where an actual label is pasted in the book. The double symbol + + indicates substances which are so poisonous as to be kept in a locked closet, and

the symbol +S+ indicates that the substance comes under the narcotic law corresponding to our Harrison Act. We are surprised in this list to find phenacetin and adrenalin classed as poisons requiring a warning label.

One of the most valuable tables is that of the list of official substances that should be protected from light.

On the whole, the work is interesting and valuable, and is especially illuminating, with reference to the way in which pharmacy is practiced in Belgium.

C. H. LaWall.

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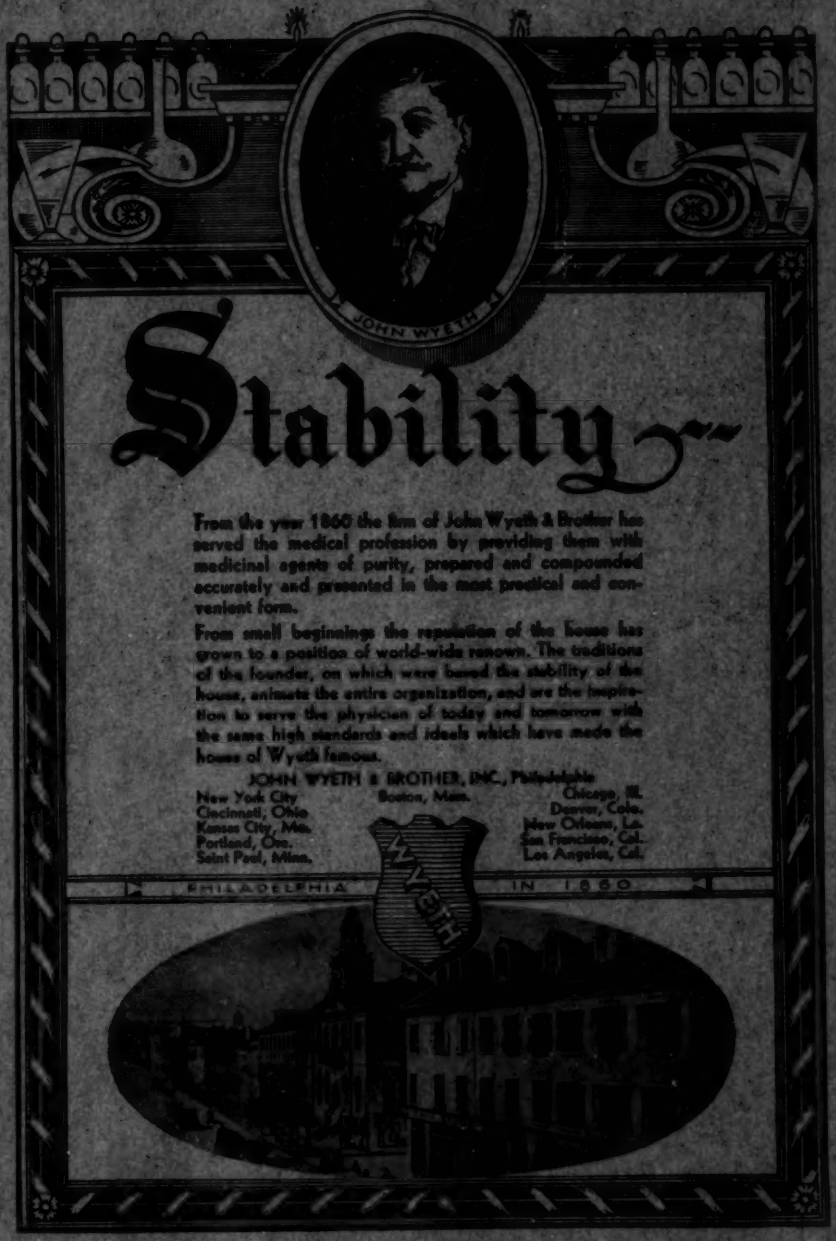

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